Flight Test Evaluation of the Stanford University/United Airlines Differential GPS Category III Automatic Landing System

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INTRODUCTION

The Federal Aviation Administration (FAA) has established a program to evaluate the technical feasibility of using Differential Global Positioning System (DGPS) based technology for International Civil Aviation Organization (ICAO) Category (CAT) IIIB precision approach and landing applications. This program includes evaluation of DGPS systems developed by independent researchers/contractors onboard test aircraft provided by member airlines of the Air Transport Association.

The overall objective here was to verify that the Stanford University/United Airlines DGPS system demonstrated the capability to meet the requirements for accuracy and integrity, as specified in the FAA CAT III Level 2 Flight Test Plan [2], over at least 91 completed CAT IIIB approach and autolandings.

Specific objectives were:


2. **Integrity Monitor Response**: Determine whether the CAT IIIB equipment integrity monitor response had a low alarm rate and detected out of tolerance total system and navigation sensor errors. The CAT IIIB equipment was expected to detect all satellite signal anomalies which did occur. In addition, the CAT IIIB equipment was not expected to generate any false alarms.

The Stanford University/United Airlines system performance was compared to Measures of Success (MOSs) as specified in the FAA CAT III Level 2 Flight Test Plan, where determination of successful performance was based on statistical hypothesis testing. For the Stanford University/United Airlines system to be considered successful, MOSs based on total system error must have successful performance [2]. MOSs based on navigation sensor error were included to acquire additional information on system performance, but the primary interest was in total system error.

ACCURACY AND INTEGRITY REQUIREMENTS

The RNP specifies system accuracy in terms of total system error, as opposed to navigation sensor error as currently specified for ILS. For precision approaches, the RNP describes the required accuracy via two concentric rectangular tunnels that surround the final approach path to the landing runway [1]. Both tunnels are centered around the 3 degree glide path that intercepts the runway 954 ft past the threshold and decrease in lateral and vertical size as the runway intercept point is reached.

The inner tunnel defines a region within which the aircraft's Center of Gravity (CG) must be contained a minimum of 95 percent of the time. Associated with the inner tunnel is a two-dimensional touchdown dispersion box that extends ±27 ft laterally from the runway.
centerline and ±750 ft longitudinally from the runway intercept point. The aircraft CG must be contained within this box at touchdown a minimum of 95 percent of the time.

The outer tunnel defines a region beyond which no part of the aircraft is allowed to extend with a probability greater than 1 in 10^7 landings.

The navigation sensor error is specified in terms of two parameters: Path Following Error (PFE) and Control Motion Noise (CMN). With regard to MLS, PFE is defined as that portion of the guidance system error which will result in an actual aircraft displacement from the desired flight path [5]. CMN is defined as that portion of the guidance system error which, when coupled to the autopilot, results in control surface, wheel and column motion, and possibly attitude angle change, but does not cause aircraft displacement from the desired flight path [5].

The integrity under normal operating conditions is specified in terms of false alarms, missed alarms and time to alarm. A maximum of one false alarm is allowed and there can be no missed alarms. In addition, any alarm condition must be acknowledged in two seconds or less.

The specific accuracy requirements for MOS 1 through MOS 4 as well as the specific integrity requirements for MOS 6 and MOS 7 are described in detail in the FAA CAT III Level 2 Flight Test Plan.

FLIGHT TEST FACILITIES

All test flights were conducted at NASA Ames Research Center's Crows Landing Flight Facility, located in the San Joaquin Valley approximately 45 miles East of the NASA Ames Research Center. The NASA test facility at Crows Landing includes two Nike X-band monopulse radar trackers and one precision NiYag laser tracker. The laser tracker provides precise aircraft range, azimuth and elevation and is used to provide the GPS time-tagged truth reference data by tracking a laser retro-reflector mounted on the test aircraft.

The stated laser tracker range accuracy is nominally ±1 ft (1σ) out to 30,000 ft; azimuth and elevation accuracy are nominally ±0.2 mrad (1σ). These values equate to an estimated position error of ±0.230 m along-track, ±0.489 m laterally and ±0.448 m vertically at the 100 ft Height Above Threshold (HAT) position along the 3 degree approach path (2230 m from the laser tracker). However, experience with the laser tracker during this and other approach and landing flight tests has demonstrated accuracies which are consistently better than shown above.

The laser tracker was calibrated immediately prior to the start of the series of approaches during each test flight. In addition, the laser tracker was checked after each approach by tracking a static laser retro-reflector mounted at a survey point located approximately underneath the 100 ft HAT position along the 3 degree approach path (See Figure 1).

In the laser truth reference data post-processing, laser range, azimuth and elevation data were wild-pointed and smoothed with a zero phase-shift, low-pass digital filter. The static laser check data were then used to identify laser range, azimuth and elevation biases as a function of time. The laser truth reference data were corrected for refraction errors, and finally converted to the rectangular Runway Coordinate System (RCS).
Figure 2 shows a laser truth reference position error of $\pm 0.061$ m ($1\sigma$) laterally and $\pm 0.084$ m ($1\sigma$) vertically at the static laser retro-reflector position (2420 m from the laser tracker) for a five minute laser track of the static laser retro-reflector on the last day of the flight test. This data is the result of the above mentioned post-processing steps and is characteristic of static laser checks of this and other approach and landing flight tests conducted at Crows Landing.
FLIGHT TEST DESCRIPTION

The flight test consisted of standard 3 degree glide path straight-in approaches terminating with autolandings to Runway 35 at the Crows Landing Flight Facility (See Figure 3). Each approach was started at the Initial Approach Fix (IAF) located five nautical miles out along the runway centerline with the test aircraft established on speed, on course, on glide path, configured for autolanding with all data collection equipment operational.

Laser tracking data were recorded from the time the test aircraft crossed the Final Approach Fix (FAF), located three and a quarter nautical miles out along the runway centerline, through autolanding and the subsequent touch and go or landing roll-out. At the completion of the touch and go, the test aircraft was flown back to the IAF (via the test pattern depicted in Figure 4), to set up for another approach. Ten percent of the autolandings terminated with a full stop, followed immediately with a takeoff to set up for another approach.

All of the approach and landings, from the FAF to touchdown, were accomplished with the guidance coupled to the autopilot. Upon touchdown, the autopilot was disengaged,
and the pilot assumed control of the aircraft. All test flights were flown in day Visual Meteorological Conditions (VMC).

Figure 3 Crows Landing Flight Facility Runway 35 Approach

After the test aircraft initiated the touch and go or takeoff, the laser tracker was used to track the static laser retro-reflector, located on the runway centerline approximately 1600 ft prior to the Runway 35 Threshold (See Figure 1), to perform the laser tracker calibration check as discussed in the previous section. At the completion of the laser
track of the static laser retro-reflector, the laser tracker re-acquired the test aircraft on its turn from base to final.

![Diagram](image)

**Figure 4 Crows Landing Flight Facility Runway 35 Flight Test Pattern**

**FLIGHT TEST RESULTS**

All of the 100 approaches and autlandings evaluated were accomplished at the Crows Landing Flight Facility between 11 and 14 October 1994. Using the laser tracker as ground truth reference, both total system error and navigation sensor error were measured and evaluated for all of the approaches and autlandings. For the Stanford University/United Airlines system to be considered successful, MOSs based on total system error must achieve successful performance. MOSs based on navigation sensor error were included to acquire additional information on system performance, but the primary interest was in total system error. Refer to the FAA CAT III Level 2 Flight Test Plan for a complete discussion of the individual MOSs as well as the data processing procedures for each of the different MOSs.

**Vertical Navigation Sensor Error**

Evaluation of the vertical navigation sensor error, MOS 1, was based on passing the difference between the laser tracker truth reference and the vertical navigation sensor error (both referenced to the navigation reference point (NRP)) through the vertical PFE and CMN ICAO Annex 10 filters for MLS evaluation. The vertical PFE and CMN filter outputs were compared to the 95 percent thresholds from the 700 ft HAT position to the 50 ft HAT position. Estimation statistics were evaluated on the ensemble data from the 1000 ft HAT position through autolanding and the subsequent touch and go or landing roll-out to further characterize the flight test results. Refer to Appendix B for all MOS 1 statistics and plots as required by the FAA CAT III Level 2 Flight Test Plan.

Of the 100 approaches and autlandings evaluated, 50 failed MOS 1 specifications, resulting in the failure of MOS 1. All of the approaches that failed MOS 1 did so by exceeding the vertical PFE filter limits prior to reaching approximately the 500 ft HAT position. This position coincides with the position where the transition from the less accurate code-based solution to the more accurate kinematic solution occurs. In addition, these transitions created relatively large vertical position discontinuities in several of the
50 approaches that failed MOS 1, which in turn resulted in CMN filter spikes that exceeded the vertical CMN filter limits.

**Lateral Navigation Sensor Error**

Evaluation of the lateral navigation sensor error, MOS 2, was based on passing the difference between the laser tracker truth reference and the lateral navigation sensor error (both referenced to the NRP) through the lateral PFE and CMN ICAO Annex 10 filters for MLS evaluation. The lateral PFE and CMN filter outputs were compared to the 95 percent thresholds from the 200 ft HAT position through autolanding and the subsequent touch and go or landing roll-out. Estimation statistics were evaluated on the ensemble data from the 1000 ft HAT position through autolanding and the subsequent touch and go or landing roll-out to further characterize the flight test results. Refer to Appendix B for all MOS 2 statistics and plots as required by the FAA CAT III Level 2 Flight Test Plan.

All 100 of the approaches and autolandings passed MOS 2 specifications, resulting in the success of MOS 2.

**Vertical Total System Error**

Evaluation of the vertical total system error, MOS 3, was based on the difference between the test aircraft NRP vertical position, as determined by the laser tracker, and the vertical position the NRP should have been at on the desired flight path. The total system vertical error was evaluated relative to the inner RNP vertical tunnel limits from the 700 ft HAT position to the 50 ft HAT position. Estimation statistics were evaluated on the ensemble data from the 1000 ft HAT position through autolanding and the subsequent touch and go or landing roll-out to further characterize the flight test results. Refer to Appendix A for all MOS 3 statistics and plots as required by the FAA CAT III Level 2 Flight Test Plan.

Of the 100 approaches and autolandings evaluated, only two failed MOS 3 specifications, resulting in the success of MOS 3. The two approaches that failed MOS 3 did so by exceeding the lower inner RNP vertical tunnel limits prior to reaching approximately the 500 ft HAT position. Again, this position coincides with the position where the transition from the less accurate code-based solution to the more accurate kinematic solution occurs. The relatively large vertical position discontinuity at this transition point combined with the slow autopilot response resulted in an over-shoot of the desired glide path and subsequent penetration of the upper inner RNP vertical tunnel limits prior to settling down on the desired glide path.

It is interesting to note that the two approaches that failed MOS 3 occurred on two different days separated exactly by 23 hours and 56 minutes. In other words, it appears that the test aircraft was in the same position in space, with the same satellite geometry for both of the approaches. Both the Horizontal Dilution of Precision (HDOP) and Vertical Dilution of Precision (VDOP) values, as well as the number of satellites, were the same for both of the approaches. In addition, the error trajectory plots for each of the two approaches were very similar.

**Lateral Total System Error**

Evaluation of the lateral total system error, MOS 4, was based on the difference between the test aircraft NRP lateral position, as determined by the laser tracker, and the lateral position the NRP should have been at on the desired flight path. The total system lateral error was evaluated relative to the inner RNP lateral tunnel limits from the 200 ft HAT position through autolanding and the subsequent touch and go or landing roll-out.
Estimation statistics were evaluated on the ensemble data from the 1000 ft HAT position through autolanding and the subsequent touch and go or landing roll-out to further characterize the flight test results. Refer to Appendix A for all MOS 4 statistics and plots as required by the FAA CAT III Level 2 Flight Test Plan.

All 100 of the approaches and autolandings passed MOS 4 specifications, resulting in the success of MOS 4.

**Touchdown Dispersion**

Evaluation of the touchdown dispersion, MOS 5, was based on longitudinal and lateral total system error at the touchdown point. The total system longitudinal error was evaluated relative to the 1500 ft long touchdown dispersion box while the total system lateral error was evaluated relative to the inner RNP lateral tunnel limits. Estimation statistics were evaluated on the ensemble data from touchdown through the subsequent touch and go or landing roll-out to further characterize the flight test results. Refer to Appendix A for all MOS 5 statistics and plots as required by the FAA CAT III Level 2 Flight Test Plan.

All 100 of the approaches and autolandings passed MOS 5 specifications, resulting in the success of MOS 5. All of the touchdowns were accomplished with the outboard landing gear position less than 145 ft away from the runway centerline.

**Integrity Under Normal Operation**

Evaluation of the integrity under normal operation, MOS 6, was based on determining the number of missed alarms and false alarms along an approach as well as the time to alarm. For the total system error evaluation, the total system error was compared to the outer RNP tunnel boundary minus the approximate dimensions of a Boeing 747 aircraft. For the navigation sensor error evaluation, the navigation sensor error was compared to ILS CAT III monitor limits for position errors. The true alarm state was determined by the ground truth reference provided by the laser tracker. Estimation statistics were not evaluated due the fact that few or no alarms were expected.

All 100 of the approaches and autolandings passed MOS 6 specifications, using both the navigation sensor error analysis as well as the total system error analysis, resulting in the success of MOS 6. There were no integrity alarms during any of the 100 approaches and autolandings evaluated. In addition, there were no vertical or lateral missed or false alarms.

**Integrity Under Artificial Alarm Limits**

Evaluation of the integrity under artificial alarm limits, MOS 7, was not accomplished on the Stanford University/United Airlines system.

**SUMMARY OF RESULTS**

Refer to Table 1 for a summary of all of the requirements compared to the actual performance, as well as a Pass or Fail score for each of the MOSs evaluated.
Table 1 Summary of Performance vs. MOS

<table>
<thead>
<tr>
<th>MOS #</th>
<th>Description</th>
<th>Performance</th>
<th>Reg'd</th>
<th>Pass/Fail</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>Vertical Navigation Sensor Error: PFE and CMN</td>
<td>50 successful/100</td>
<td>91/100</td>
<td>Fail</td>
</tr>
<tr>
<td>2</td>
<td>Lateral Navigation Sensor Error: PFE and CMN</td>
<td>100 successful/100</td>
<td>91/100</td>
<td>Pass</td>
</tr>
<tr>
<td>3</td>
<td>Vertical Total System Error</td>
<td>98 successful/100</td>
<td>91/100</td>
<td>Pass</td>
</tr>
<tr>
<td>4</td>
<td>Lateral Total System Error</td>
<td>100 successful/100</td>
<td>91/100</td>
<td>Pass</td>
</tr>
<tr>
<td>5</td>
<td>Touchdown Dispersion:</td>
<td>100 successful/100</td>
<td>91/100</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Lateral and Longitudinal Touchdown Dispersion</td>
<td>0</td>
<td>≤1</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Outboard Landing Gear &lt; 145 ft From Centerline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Integrity Under Normal Operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vertical:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time-To-Alarm Always ≤2 Seconds</td>
<td>Yes</td>
<td>Yes</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Number of Missed Alarms</td>
<td>0</td>
<td>0</td>
<td>Pass</td>
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<tr>
<td></td>
<td>Lateral:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time-To-Alarm Always ≤2 Seconds</td>
<td>Yes</td>
<td>Yes</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Number of Missed Alarms</td>
<td>0</td>
<td>0</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Number of Vertical and Lateral False Alarms</td>
<td>0</td>
<td>≤1</td>
<td>Pass</td>
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<td>7</td>
<td>Integrity Under Artificial Alarm Limits</td>
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<td>Vertical:</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>Time-To-Alarm Always ≤2 Seconds</td>
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<td>Yes</td>
<td>N/A</td>
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<td>Number of Missed Alarms</td>
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<td>N/A</td>
</tr>
<tr>
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<td>Number of Alarms Per Minute</td>
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<td>~1</td>
<td>N/A</td>
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<tr>
<td></td>
<td>Lateral:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time-To-Alarm Always ≤2 Seconds</td>
<td>N/A</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Number of Missed Alarms</td>
<td>N/A</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Number of Alarms Per Minute</td>
<td>N/A</td>
<td>~1</td>
<td>N/A</td>
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<tr>
<td></td>
<td>Number of Vertical and Lateral False Alarms</td>
<td>N/A</td>
<td>≤1</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Refer to Appendix A for the total system error, and to Appendix B for the navigation sensor error estimation statistics as well as all ensemble plots specified in the FAA CAT III Level 2 Flight Test Plan. Appendix C contains the individual approach and autolanding data and corresponding plots for each of the 100 approaches and autolandings.

CONCLUSIONS

The Stanford University/United Airlines system met the requirements for a successful approach and autolanding, based on the total system error requirements, 98 out of 100 approaches and autolandings, thereby satisfying all of the total system error MOSs. Based on navigation sensor error, 50 out of 100 approaches and autolandings failed MOS 1 specifications, however, the remaining navigation sensor error MOS specifications were satisfied.

All of the unsuccessful approaches were due to the relatively inaccurate code-based solution. Once the transition to a kinematic solution occurred, the remainder of the
approach and subsequent autolanding was within the limits specified by all of the MOSs. Had this transition occurred prior to the 850 ft HAT position, where the vertical analysis began, all 100 approaches would have been successful, for both the total system error evaluation as well as the navigation sensor error evaluation.

LIST OF REFERENCES

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   "Required Navigation Performance (RNP) for Precision Approach and Landing with GNSS Application"

2. O'Donnell, P. and Braff, R.
   "Category (CAT) IIIb Level 2 Flight Test Plan for the Global Positioning System (GPS)"
   The MITRE Corporation, May 1994

3. Federal Aviation Administration
   "Automatic Landing Systems"
   AC 20-57A, 12 January 1971

4. Federal Aviation Administration
   "Criteria for Approval of Category III Landing Weather Minima"
   AC 120-28C, 3 September 1984

5. International Civil Aviation Organization
   "International Standards, Recommended Practices and Procedures for Air Navigation Services, Aeronautical Telecommunication"
   Annex 10, Convention on International Civil Aviation, Volume 1, April 1985
APPENDIX A

TOTAL SYSTEM ERROR RESULTS
INTENTIONALLY
LEFT
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### VRT Total System Accuracy Performance for MDS 3

**SUCCESSFUL APPROACHES:** 98  
**VALID APPROACHES:** 100

| Location | \(| | \text{VSE} \) | \(| | \text{VST} \) | \(| | \text{VSE} \) | \(| | \text{VTSE} \) |
|----------|------------------|------------------|------------------|------------------|
| 1000FT HAT | 3.132 | -2.476 | 3.132 | 0.657 |
| 900FT HAT | 2.494 | -2.201 | 2.494 | 0.293 |
| 800FT HAT | 2.146 | -2.143 | 2.146 | 0.003 |
| 700FT HAT | 2.073 | -2.128 | 2.073 | -0.145 |
| 600FT HAT | 2.187 | -2.244 | 2.187 | -0.056 |
| 500FT HAT | 1.906 | 0.430 | 1.906 | 2.336 |
| 400FT HAT | -1.008 | 0.415 | -1.008 | -0.593 |
| 300FT HAT | -1.578 | 0.217 | -1.578 | -1.361 |
| 200FT HAT | -0.667 | 0.193 | -0.667 | -0.475 |
| 100FT HAT | -0.227 | 0.152 | -0.227 | -0.075 |
| 50FT HAT | -0.132 | 0.066 | -0.132 | -0.066 |

### VRT Total System Accuracy Estimation Statistics

| Location | \(| | \text{VSE} \) | \(| | \text{VST} \) | \(| | \text{VSE} \) | \(| | \text{VTSE} \) |
|----------|------------------|------------------|------------------|------------------|
| 1000FT HAT | 6.750 | 6.686 | 6.750 | 3.846 |
| 900FT HAT | 6.808 | 6.612 | 6.808 | 2.564 |
| 800FT HAT | 6.929 | 6.557 | 6.929 | 1.551 |
| 700FT HAT | 6.898 | 6.523 | 6.898 | 1.465 |
| 600FT HAT | 6.668 | 6.453 | 6.668 | 1.125 |
| 500FT HAT | 5.779 | 5.096 | 5.779 | 5.699 |
| 400FT HAT | 2.942 | 0.199 | 2.942 | 2.859 |
| 300FT HAT | 3.692 | 0.151 | 3.692 | 3.662 |
| 200FT HAT | 1.208 | 0.116 | 1.208 | 1.319 |
| 100FT HAT | 1.089 | 0.096 | 1.089 | 1.091 |
| 50FT HAT | 1.024 | 0.085 | 1.024 | 1.024 |
| LOCATION | \( |u| \pm 2\text{SIG(m)} \) | 2\text{RMS(m)} \( 95\% \) \( 2\text{SIGUCL(m)} \) |
|----------|-----------------|------------|-----------------|
| 1000FT HAT | 0.000 0.010 | 0.003 0.008 | 0.009 0.017 |
| 900FT HAT | 0.001 0.012 | 0.006 0.011 | 0.012 0.021 |
| 800FT HAT | 0.002 0.014 | 0.008 0.013 | 0.014 0.023 |
| 700FT HAT | 0.003 0.016 | 0.010 0.016 | 0.016 0.026 |
| 600FT HAT | 0.004 0.018 | 0.012 0.022 | 0.020 0.031 |
| 500FT HAT | 0.005 0.020 | 0.016 0.026 | 0.026 0.039 |
| 400FT HAT | 0.006 0.022 | 0.018 0.032 | 0.032 0.050 |
| 300FT HAT | 0.009 0.030 | 0.024 0.038 | 0.040 0.064 |
| 200FT HAT | 0.014 0.044 | 0.033 0.052 | 0.060 0.106 |
| 100FT HAT | 0.024 0.069 | 0.059 0.085 | 0.105 0.190 |
| AIM POINT | 0.036 0.106 | 0.108 0.159 | 0.165 0.273 |
| AP + 0.05NM | 0.039 0.107 | 0.110 0.164 | 0.170 0.295 |
| AP + 0.10NM | 0.046 0.161 | 0.118 0.193 | 0.210 0.386 |
| AP + 0.15NM | 0.058 0.250 | 0.159 0.275 | 0.325 0.635 |
| AP + 0.20NM | 0.075 0.365 | 0.210 0.380 | 0.515 1.115 |
| AP + 0.25NM | 0.099 0.510 | 0.280 0.465 | 0.725 1.585 |

**LAT TOTAL SYSTEM ACCURACY ESTIMATION MEAN (m)**

<table>
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<tr>
<th>LOCATION</th>
<th>LPTE</th>
<th>LSE</th>
<th>LTSE</th>
<th>LTSE ( \text{estimate} )</th>
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<td>1000FT HAT</td>
<td>-0.613 0.819</td>
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<td>0.206</td>
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<tr>
<td>900FT HAT</td>
<td>-0.944 0.645</td>
<td>-0.944</td>
<td>-0.298</td>
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<tr>
<td>800FT HAT</td>
<td>-1.129 0.489</td>
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<td>-0.640</td>
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<tr>
<td>700FT HAT</td>
<td>-1.083 0.467</td>
<td>-1.083</td>
<td>-0.677</td>
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<tr>
<td>600FT HAT</td>
<td>-1.352 0.266</td>
<td>-1.352</td>
<td>-0.987</td>
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<tr>
<td>500FT HAT</td>
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<td>-0.773</td>
<td>-0.853</td>
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<tr>
<td>400FT HAT</td>
<td>-0.497 0.014</td>
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<td>-0.483</td>
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<tr>
<td>300FT HAT</td>
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<td>-0.586</td>
<td>-0.526</td>
<td></td>
</tr>
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<td>-0.217</td>
<td>-0.282</td>
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<tr>
<td>100FT HAT</td>
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<tr>
<td>50FT HAT</td>
<td>-0.004 0.184</td>
<td>-0.004</td>
<td>-0.188</td>
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<tr>
<td>AIM POINT</td>
<td>0.047 -0.177</td>
<td>0.047</td>
<td>-0.130</td>
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<td>-0.356 -0.083</td>
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<td>AP + 0.40NM</td>
<td>-0.557 -0.067</td>
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<tr>
<td>AP + 0.50NM</td>
<td>-0.584 -0.079</td>
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<tr>
<td>AP + 0.55NM</td>
<td>-0.212 -0.172</td>
<td>-0.212</td>
<td>-0.394</td>
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**LAT TOTAL SYSTEM ACCURACY ESTIMATION STD DEVM(m)**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>LPTE</th>
<th>LSE</th>
<th>LTSE</th>
<th>LTSE ( \text{estimate} )</th>
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<tr>
<td>1000FT HAT</td>
<td>0.997 2.097</td>
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<td>900FT HAT</td>
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<td>7.126 2.075</td>
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<td>700FT HAT</td>
<td>5.545 1.954</td>
<td>5.545</td>
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<tr>
<td>600FT HAT</td>
<td>4.476 1.910</td>
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<td>3.283 0.317</td>
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<tr>
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<td>2.595 0.223</td>
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<tr>
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<td>50FT HAT</td>
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<td>1.818</td>
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<td>1.814</td>
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<tr>
<td>AP + 0.15NM</td>
<td>1.877 0.126</td>
<td>1.877</td>
<td>1.880</td>
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<td>AP + 0.40NM</td>
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<td>1.624</td>
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<td>AP + 0.45NM</td>
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<td>1.424</td>
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<td>1.313</td>
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<td>AP + 0.55NM</td>
<td>0.959 0.107</td>
<td>0.959</td>
<td>0.955</td>
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</table>
**TOUCHDOWN DISPERSION PERFORMANCE FOR MDS 5**

SUCCESSFUL TOUCHDOWNS: 100
VALID TOUCHDOWNS: 100
MAIN LANDING GEAR LESS THAN 145 FT FROM CL
TOUCHDOWN AT LEAST 200 FT PAST THRESHOLD

$\text{LOCATION} \quad |u| + 2\text{SIG}(m) \quad 2\text{RMS}(m) \quad 95P(m) \quad 2\text{SIG}UCL(m)$

| LOCATION  | $|u| + 2\text{SIG}(m)$ | $2\text{RMS}(m)$ | $95P(m)$ | $2\text{SIG}UCL(m)$ |
|-----------|------------------------|-----------------|----------|---------------------|
| TOUCHDOWN | 4.434                  | 4.010           | 3.652    | 9.797               |
| TD+0.05NM | 4.422                  | 3.991           | 4.203    | 9.623               |
| TD+0.10NM | 4.594                  | 4.143           | 4.512    | 10.318              |
| TD+0.15NM | 4.696                  | 4.279           | 4.451    | 11.468              |
| TD+0.20NM | 4.501                  | 4.288           | 4.291    | 12.254              |
| TD+0.25NM | 3.915                  | 3.781           | 3.888    | 9.590               |
| TD+0.30NM | 3.750                  | 3.461           | 3.814    | 7.719               |
| TD+0.35NM | 3.251                  | 2.954           | 3.162    | 5.434               |
| TD+0.40NM | 2.771                  | 2.546           | 2.421    | 4.255               |
| TD+0.45NM | 2.277                  | 2.156           | 2.273    | 3.625               |
| TD+0.50NM | 1.716                  | 1.608           | 1.142    | 17.365              |
* LAT AND VRT INTEGRITY PERFORMANCE FOR MOS 6 *

VERTICAL TIME TO ALARM 2 SECONDS OR LESS
NUMBER OF MISSED VERTICAL ALARMS: 0
NUMBER OF FALSE VERTICAL ALARMS: 0

LATERAL TIME TO ALARM 2 SECONDS OR LESS
NUMBER OF MISSED LATERAL ALARMS: 0
NUMBER OF FALSE LATERAL ALARMS: 0

$\$$\$$\$$\$$\$$\$$
$\$$\$$\$$\$$\$$\$$
$\$$\$$\$$\$$\$$\$$
LATERAL AND VERTICAL TOTAL SYSTEM DIFF FOR ALL VALID APPROACHES

NRP Xrcs Position (m)

NRP Yrcs Tot Sys Diff (m)

NRP Zrcs Tot Sys Diff (m)

NRP Xrcs Position (m)
LAT AND VERT TOTAL SYSTEM DIFF ESTIMATE FOR ALL VALID APPROACHES

NRP Yrcs Tot Sys Diff Est (m)

NRP Zrcs Tot Sys Diff Est (m)

NRP Xrcs Position (m)
LAT AND VERT TOT SYS DIFF EST DEVIATION FOR ALL VALID APPROACHES

LAT and Vert Tot Sys Diff Est Dev (m)

NRP Xrcs Position (m)

NRP Yrcs Tot Sys Diff Est Dev (m)

NRP Zrcs Tot Sys Diff Est Dev (m)
VERT TOTAL SYS DIFF AND VDOP FOR ALL APPROACHES FAILING MOS 3

NRP - Zrcs Tot Sys Diff (m)

VDOP

NRP Xrcs Position (m)
ENSEMBLE LTSE MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

![Graph 1: Ensemble LTSE Mean vs NRP Xrcs Position (m)]

- Y-axis: Ensemble LTSE Mean (m)
- X-axis: NRP Xrcs Position (m)

![Graph 2: Ensemble LTSE Std Dev vs NRP Xrcs Position (m)]

- Y-axis: Ensemble LTSE Std Dev (m)
- X-axis: NRP Xrcs Position (m)
ENSEMBLE LTSE ESTIMATE MEAN AND STD DEVIATION FOR ALL VALID APPROACHES

![Graph showing ensemble LTSE estimate mean and std deviation for all valid approaches.](image)

- The top graph plots the ensemble LTSE estimate mean (m) against NRP Xrcs Position (m). The x-axis ranges from -6000 to 1000, and the y-axis ranges from -1 to 0.5.
- The bottom graph plots the ensemble LTSE estimate std dev (m) against NRP Xrcs Position (m). The x-axis ranges from -6000 to 1000, and the y-axis ranges from 0 to 10.
ENSEMBLE LTSE STATISTICS FOR ALL VALID APPROACHES

![Graph showing ensemble statistics for NRP Xrcs Position (m)]
ENSEMBLE LTSE ESTIMATE STATISTICS FOR ALL VALID APPROACHES

![Graph showing ensemble LTSE estimate statistics for all valid approaches. The graph plots ensemble integrated (-) 2SIG (-) 2RMS (--) 95 PERCENTILE (--), 2SIGUC unclipped (--). The x-axis represents NRP Xrcs Position (m) ranging from -6000 to 1000, and the y-axis represents the distance in meters ranging from 0 to 250. The graph shows a decreasing trend as the NRP Xrcs Position increases.]
ENSEMBLE VTSE MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

![Graph showing ensemble VTSE mean and standard deviation](image)

- NRP Xrcs Position (m)
- Ensemble VTSE Mean (m)
- Ensemble VTSE Std Dev (m)
ENSEMBLE VTSE ESTIMATE MEAN AND STD DEVIATION FOR ALL VALID APPROACHES

-6000 -5000 -4000 -3000 -2000 -1000 0 1000 2000 3000 4000 5000 6000
NRP Xrcs Position (m)
ENSEMBLE VTSE STATISTICS FOR ALL VALID APPROACHES

NRP Xrcs Position (m)

Ensemble li+2SIG (-) 2RMS (-) 95 Percentile (-) 2SIGUCl (-) (m)
ENSEMBLE VTSE ESTIMATE STATISTICS FOR ALL VALID APPROACHES
ENSEMBLE MEAN HDOP AND VDOP FOR ALL VALID AND SUCCESSFUL APPROACHES

Ensemble HDOP

Ensemble VDOP

NRP Xrcs Position (m)
SCATTER PLOT OF THE LGRP TOUCHDOWN POINTS FOR ALL VALID TOUCHDOWNs
ENSEMBLE ROLLOUT CONTROL LTSE MEAN AND STD DEV FOR ALL VALID APPROACHES

![Graph showing the ensemble RCLTSE mean and std dev for all valid approaches.](image)

- Ensemble RCLTSE Mean (m)
  - 1.0
  - 0.5
  - 0.0
  - -0.5

- Ensemble RCLTSE Std Dev (m)
  - 2.5
  - 2.0
  - 1.5
  - 1.0
  - 0.5

LGRP Distance From Touchdown (m)
ENSEMBLE ROLLOUT CONTROL LTSE STATISTICS FOR ALL VALID APPROACHES
APPENDIX B

NAVIGATION SENSOR ERROR RESULTS
**VERTICAL PPE AND CNM PERFORMANCE FOR MOS 1**

SUCCESSFUL APPROACHES: 50
VALID APPROACHES: 100

* FAIL MOS 1 *

### | Location | 500FTHAT | 600FPTHAT | 700FPTHAT | 800FPTHAT | 900FPTHAT | 1000FPTHAT |
---|---|---|---|---|---|---|---|
| 1000FPTHAT | 15.848 | 14.259 | 14.462 | 120.655 |
| 900FPTHAT | 15.426 | 13.938 | 14.225 | 118.007 |
| 800FPTHAT | 15.256 | 13.796 | 13.678 | 116.025 |
| 700FPTHAT | 15.263 | 13.779 | 14.528 | 114.831 |
| 600FPTHAT | 15.149 | 13.663 | 14.974 | 112.372 |
| 500FPTHAT | 3.234 | 3.096 | 3.338 | 6.403 |
| 400FPTHAT | 0.756 | 0.866 | 0.734 | 0.082 |
| 300FPTHAT | 0.494 | 0.549 | 0.424 | 0.042 |
| 200FPTHAT | 0.406 | 0.444 | 0.387 | 0.030 |
| 100FPTHAT | 0.329 | 0.347 | 0.287 | 0.022 |
| AIM POINT | 0.214 | 0.197 | 0.184 | 0.018 |
| AP+0.05NM | 0.216 | 0.200 | 0.200 | 0.015 |
| AP+0.10NM | 0.214 | 0.205 | 0.192 | 0.013 |
| AP+0.15NM | 0.218 | 0.242 | 0.239 | 0.021 |
| AP+0.20NM | 0.243 | 0.219 | 0.216 | 0.023 |
| AP+0.25NM | 0.241 | 0.216 | 0.228 | 0.027 |
| AP+0.30NM | 0.218 | 0.195 | 0.184 | 0.021 |
| AP+0.35NM | 0.291 | 0.284 | 0.234 | 0.023 |
| AP+0.40NM | 0.303 | 0.294 | 0.249 | 0.025 |
| AP+0.45NM | 0.291 | 0.262 | 0.240 | 0.033 |
| AP+0.50NM | 0.271 | 0.248 | 0.228 | 0.039 |
| AP+0.55NM | 0.243 | 0.217 | 0.168 | 0.256 |
SUCCESSFUL APPROACHES: 100
VALID APPROACHES: 100

### Unfiltered Lateral Error Estimation Statistics

| Location | $|u|+2\sigma (m)$ | $2\sigma_{lm} (m)$ | $95\% (m)$ | $2\sigma_{x\Delta CL} (m)$ |
|----------|----------------|-------------------|-------------|--------------------------|
| 1000FT HAT | 5.435 | 4.898 | 4.715 | 14.377 |
| 900FT HAT | 4.849 | 4.397 | 4.152 | 11.921 |
| 800FT HAT | 4.538 | 4.263 | 3.985 | 11.617 |
| 700FT HAT | 4.315 | 3.992 | 3.793 | 10.307 |
| 600FT HAT | 4.185 | 3.889 | 3.625 | 9.842 |
| 500FT HAT | 0.714 | 0.654 | 0.782 | 0.272 |
| 400FT HAT | 0.460 | 0.447 | 0.433 | 0.134 |
| 300FT HAT | 0.371 | 0.332 | 0.325 | 0.063 |
| 200FT HAT | 0.286 | 0.256 | 0.258 | 0.033 |
| 100FT HAT | 0.365 | 0.362 | 0.310 | 0.033 |
| AIM POINT | 0.463 | 0.455 | 0.461 | 0.055 |
| AP+0.05NM | 0.473 | 0.453 | 0.518 | 0.063 |
| AP+0.10NM | 0.448 | 0.428 | 0.432 | 0.058 |
| AP+0.15NM | 0.382 | 0.362 | 0.411 | 0.043 |
| AP+0.20NM | 0.422 | 0.397 | 0.437 | 0.060 |
| AP+0.25NM | 1.064 | 0.964 | 1.070 | 0.413 |
| AP+0.30NM | 0.757 | 0.686 | 0.241 | 0.290 |
| AP+0.35NM | 0.378 | 0.338 | 0.293 | 0.058 |
| AP+0.40NM | 0.262 | 0.253 | 0.150 | 0.031 |
| AP+0.45NM | 0.243 | 0.218 | 0.130 | 0.023 |
| AP+0.50NM | 0.196 | 0.197 | 0.165 | 0.009 |
| AP+0.55NM | 0.386 | 0.405 | 0.302 | 0.316 |

### Lat Control Motion Noise Estimation Statistics

| Location | $|u|+2\sigma (m)$ | $2\sigma_{lm} (m)$ | $95\% (m)$ | $2\sigma_{x\Delta CL} (m)$ |
|----------|----------------|-------------------|-------------|--------------------------|
| 1000FT HAT | 0.478 | 0.455 | 0.446 | 0.138 |
| 900FT HAT | 0.460 | 0.414 | 0.404 | 0.103 |
| 800FT HAT | 0.449 | 0.402 | 0.366 | 0.092 |
| 700FT HAT | 0.376 | 0.340 | 0.327 | 0.071 |
| 600FT HAT | 0.290 | 0.289 | 0.303 | 0.056 |
| 500FT HAT | 1.863 | 1.728 | 2.064 | 1.939 |
| 400FT HAT | 0.334 | 0.313 | 0.303 | 0.064 |
| 300FT HAT | 0.220 | 0.204 | 0.196 | 0.027 |
| 200FT HAT | 0.193 | 0.174 | 0.152 | 0.014 |
| 100FT HAT | 0.142 | 0.127 | 0.135 | 0.009 |
| AIM POINT | 0.206 | 0.194 | 0.185 | 0.025 |
| AP+0.05NM | 0.224 | 0.211 | 0.227 | 0.029 |
| AP+0.10NM | 0.222 | 0.205 | 0.245 | 0.027 |
| AP+0.15NM | 0.203 | 0.183 | 0.194 | 0.020 |
| AP+0.20NM | 0.191 | 0.173 | 0.177 | 0.018 |
| AP+0.25NM | 0.756 | 0.660 | 0.846 | 0.250 |
| AP+0.30NM | 0.481 | 0.436 | 0.358 | 0.117 |
| AP+0.35NM | 0.264 | 0.236 | 0.237 | 0.030 |
| AP+0.40NM | 0.358 | 0.306 | 0.193 | 0.057 |
| AP+0.45NM | 0.226 | 0.203 | 0.124 | 0.024 |
| AP+0.50NM | 0.174 | 0.169 | 0.063 | 0.019 |
| AP+0.55NM | 0.249 | 0.223 | 0.171 | 0.282 |

### Lat Path Following Error Estimation Statistics

| Location | $|u|+2\sigma (m)$ | $2\sigma_{lm} (m)$ | $95\% (m)$ | $2\sigma_{x\Delta CL} (m)$ |
|----------|----------------|-------------------|-------------|--------------------------|
| 1000FT HAT | 3.419 | 3.085 | 3.042 | 5.739 |
| 900FT HAT | 4.953 | 4.476 | 4.151 | 12.187 |
| 800FT HAT | 4.669 | 4.259 | 3.947 | 11.402 |
| 700FT HAT | 4.388 | 4.039 | 3.797 | 10.461 |
| 600FT HAT | 4.195 | 3.903 | 3.724 | 9.394 |
| 500FT HAT | 1.729 | 1.675 | 1.909 | 1.889 |
| 400FT HAT | 0.330 | 0.315 | 0.302 | 0.066 |
| 300FT HAT | 0.297 | 0.266 | 0.239 | 0.040 |
| 200FT HAT | 0.214 | 0.196 | 0.193 | 0.025 |
| 100FT HAT | 0.301 | 0.304 | 0.263 | 0.021 |
| 50FT HAT | 0.370 | 0.395 | 0.348 | 0.027 |
| AIM POINT | 0.464 | 0.479 | 0.454 | 0.047 |
| AP+0.05NM | 0.441 | 0.454 | 0.407 | 0.043 |
| AP+0.10NM | 0.428 | 0.435 | 0.437 | 0.042 |
| AP+0.15NM | 0.400 | 0.401 | 0.405 | 0.038 |
| AP+0.20NM | 0.377 | 0.371 | 0.411 | 0.037 |
| AP+0.25NM | 0.423 | 0.397 | 0.507 | 0.054 |
| AP+0.30NM | 0.613 | 0.561 | 0.566 | 0.129 |
| AP+0.35NM | 0.620 | 0.556 | 0.340 | 0.154 |
| AP+0.40NM | 0.461 | 0.414 | 0.254 | 0.084 |
| AP+0.45NM | 0.317 | 0.288 | 0.217 | 0.036 |
| AP+0.50NM | 0.245 | 0.226 | 0.145 | 0.020 |
| AP+0.55NM | 0.132 | 0.208 | 0.114 | 0.006 |
LAT AND VERT INTEGRITY PERFORMANCE FOR MDS 6

VERTICAL TIME TO ALARM 2 SECONDS OR LESS
NUMBER OF MISSED VERTICAL ALARMS: 0
NUMBER OF FALSE VERTICAL ALARMS: 0

LATERAL TIME TO ALARM 2 SECONDS OR LESS
NUMBER OF MISSED LATERAL ALARMS: 0
NUMBER OF FALSE LATERAL ALARMS: 0

$\text{PASS MDS 6}$$

$\text{PASS MDS 6}$
LATERAL AND VERTICAL UNFILTERED ERROR FOR ALL VALID APPROACHES

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

-6000 -5000 -4000 -3000 -2000 -1000 0 1000

-10 0 10

NRP Zrcs Diff (m)

-30 -20 -10 0 10 20

NRP Xrcs Position (m)
LATERAL AND VERTICAL CMN FILTER OUTPUT FOR ALL VALID APPROACHES

NRP Xrcs Position (m)

Lateral CMN Filter Output (m)

Vertical CMN Filter Output (m)
VERT DIFF, PFE & CMN FILTER OUTPUT AND VDOP FOR ALL APPROACHES FAILING MOS 1
ENSEMBLE ULE MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

Ensemble ULE Mean (m)

Ensemble ULE Std Dev (m)

NRP Xrccs Position (m)
ENSEMBLE LPFE MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

Ensemble LPFE Mean (m)

NRP Xrcs Position (m)

Ensemble LPFE Std Dev (m)
ENSEMBLE LCMN MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

NRP Xrcs Position (m)

Ensemble LCMN Mean (m)

Ensemble LCMN Std Dev (m)

0.1
-0.1
-0.2
0
-6000 -5000 -4000 -3000 -2000 -1000 0 1000

0.8
0.6
0.4
0.2
0
-6000 -5000 -4000 -3000 -2000 -1000 0 1000

44
ENSEMBLE UNFILTERED LATERAL ERROR STATISTICS FOR ALL VALID APPROACHES.
ENSEMBLE LAT PATH FOLLOWING ERROR STATISTICS FOR ALL VALID APPROACHES:

![Graph showing ensemble lat path following error statistics for all valid approaches. The graph plots NRP Xrcs Position (m) against Ensemble luel+2SIG (-) and 2RMS (-) 95 PERCENTILE (-) 2SIGUCL (-) in meters (m).]
ENSEMBLE LAT CONTROL MOTION NOISE STATISTICS FOR ALL VALID APPROACHES

![Graph showing motion noise statistics for all valid approaches.](image-url)
ENSEMBLE UVE MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

-6000 -5000 -4000 -3000 -2000 -1000 0 1000

NRP Xrcs Position (m)

-6000 -5000 -4000 -3000 -2000 -1000 0 1000

NRP Xrcs Position (m)
ENSEMBLE VPFE MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

ensemble VPFE Mean (m)

ensemble VPFE Std Dev (m)

NRP Xrcs Position (m)
ENSEMBLE VCMN MEAN AND STANDARD DEVIATION FOR ALL VALID APPROACHES

Estimated VCMN Mean (m) vs. NRP Xrcs Position (m)

Estimated VCMN Std Dev (m) vs. NRP Xrcs Position (m)
ENSEMBLE UNFILTERED VERTICAL ERROR STATISTICS FOR ALL VALID APPROACHES

![Graph showing ensemble unfiltered vertical error statistics](image)
ENSEMBLE VERT PATH FOLLOWING ERROR STATISTICS FOR ALL VALID APPROACHES

Graph showing the ensemble (u+2SIG, (-) 2RMS, (-) 95 Percentile) vs NRP Xrcs Position (m).
ENSEMBLE VERT CONTROL MOTION NOISE STATISTICS FOR ALL VALID APPROACHES
ENSEMBLE MEAN HDOP AND VDOP FOR ALL VALID AND SUCCESSFUL APPROACHES

![Graph showing ensemble mean HDOP and VDOP for NRP Xrcs Position (m)]
APPENDIX C

INDIVIDUAL APPROACH AND AUTOLANDING RESULTS
**APPROACH #: SU428408**
**START TIME: 236360.999**
**STOP TIME: 236466.999**

**MINIMUM HDOP: 2.3**
**MAXIMUM HDOP: 2.4**
**AVERAGE HDOP: 2.4**

**MINIMUM VDOP: 4.0**
**MAXIMUM VDOP: 4.1**
**AVERAGE VDOP: 4.1**

**MINIMUM NUMBER OF SVs: 4**
**MAXIMUM NUMBER OF SVs: 4**
**AVERAGE NUMBER OF SVs: 4**

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

**NRP Xrcs MEAN DIFFERENCE (m): 0.225**
**NRP Yrcs MEAN DIFFERENCE (m): -0.106**
**NRP Zrcs MEAN DIFFERENCE (m): 0.160**

**NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.271**
**NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.376**
**NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.249**

**NRP Xrcs 2-RMS DIFFERENCE (m): 0.524**
**NRP Yrcs 2-RMS DIFFERENCE (m): 0.432**
**NRP Zrcs 2-RMS DIFFERENCE (m): 0.406**

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

**LGRP Xrcs POSITION (m): 128.944**
**LGRP Yrcs POSITION (m): 2.949**
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

SU428408

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428410
START TIME: 237055.749
STOP TIME: 237163.249
MINIMUM HDOP: 2.2
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3
MINIMUM VDOP: 3.6
MAXIMUM VDOP: 3.6
AVERAGE VDOP: 3.6
MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

********************
METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY
********************

********************
VALID APPROACH
********************

********************
SUCCESSFUL APPROACH
********************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.499
NRP Yrcs MEAN DIFFERENCE (m): -0.052
NRP Zrcs MEAN DIFFERENCE (m): 0.130

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.292
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.221
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.237

NRP Xrcs 2-RMS DIFFERENCE (m): 1.040
NRP Yrcs 2-RMS DIFFERENCE (m): 0.244
NRP Zrcs 2-RMS DIFFERENCE (m): 0.351

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 101.453
LGRP Yrcs POSITION (m): -0.294
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428410:

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428412
START TIME: 237524.749
STOP TIME: 237633.749

MINIMUM HDOP: 2.2
MAXIMUM HDOP: 2.2
AVERAGE HDOP: 2.2

MINIMUM VDOP: 3.4
MAXIMUM VDOP: 3.4
AVERAGE VDOP: 3.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

**********************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
**********************************************************************

**********************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
**********************************************************************

**********************************************************************
* VALID APPROACH *
**********************************************************************

**********************************************************************
* SUCCESSFUL APPROACH *
**********************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.433
NRP Yrcs MEAN DIFFERENCE (m): -0.098
NRP Zrcs MEAN DIFFERENCE (m): 0.059

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.173
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.259
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.241

NRP Xrcs 2-RMS DIFFERENCE (m): 0.884
NRP Yrcs 2-RMS DIFFERENCE (m): 0.325
NRP Zrcs 2-RMS DIFFERENCE (m): 0.268

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 111.325
LGRP Yrcs POSITION (m): 2.476
APPROACH #: SU428414
START TIME: 237954.749
STOP TIME: 238064.249

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 4.4
MAXIMUM VDOP: 4.5
AVERAGE VDOP: 4.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* VALID APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.471
NRP Yrcs MEAN DIFFERENCE (m): -0.134
NRP Zrcs MEAN DIFFERENCE (m): 0.067

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.439
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.199
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.252

NRP Xrcs 2-RMS DIFFERENCE (m): 1.038
NRP Yrcs 2-RMS DIFFERENCE (m): 0.333
NRP Zrcs 2-RMS DIFFERENCE (m): 0.285

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 136.297
LGRP Yrcs POSITION (m): 0.907

*************************************************
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428414:

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428416
START TIME: 238374.499
STOP TIME: 238482.749

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 4.7
MAXIMUM VDOP: 4.8
AVERAGE VDOP: 4.7

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY  *
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******************************
* VALID APPROACH  *
******************************

******************************
* SUCCESSFUL APPROACH  *
******************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.456
NRP Yrcs MEAN DIFFERENCE (m): -0.095
NRP Zrcs MEAN DIFFERENCE (m): 0.098

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.277
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.098
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.262

NRP Xrcs 2-RMS DIFFERENCE (m): 0.953
NRP Yrcs 2-RMS DIFFERENCE (m): 0.214
NRP Zrcs 2-RMS DIFFERENCE (m): 0.327

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 108.756
LGRP Yrcs POSITION (m): -2.461
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

SU428416

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

NRP Xrcs Position (m)
APPROACH #: SU428418
START TIME: 238819.749
STOP TIME: 238929.249

MINIMUM HDOP: 2.6
MAXIMUM HDOP: 2.6
AVERAGE HDOP: 2.6

MINIMUM VDOP: 5.1
MAXIMUM VDOP: 5.2
AVERAGE VDOP: 5.1

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************** METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *******
*************** VALID APPROACH ***************
*************** SUCCESSFUL APPROACH ***************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.642
NRP Yrcs MEAN DIFFERENCE (m): -0.534
NRP Zrcs MEAN DIFFERENCE (m): 0.083

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.589
NRP Yrcs 2-SIGMA DIFFERENCE (m): 1.522
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.266

NRP Xrcs 2-RMS DIFFERENCE (m): 1.413
NRP Yrcs 2-RMS DIFFERENCE (m): 1.859
NRP Zrcs 2-RMS DIFFERENCE (m): 0.313

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 153.172
LGRP Yrcs POSITION (m): 0.038
APPROACH #: SU428420
START TIME: 239253.749
STOP TIME: 239365.499

MINIMUM HDOP: 2.9
MAXIMUM HDOP: 3.0
AVERAGE HDOP: 2.9

MINIMUM VDOP: 5.6
MAXIMUM VDOP: 5.8
AVERAGE VDOP: 5.7

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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----------------------------
* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPXrcs MEAN DIFFERENCE (m): 0.415
NRPYrcs MEAN DIFFERENCE (m): -0.073
NRP Zrcs MEAN DIFFERENCE (m): 0.119

NRPXrcs 2-SIGMA DIFFERENCE (m): 0.220
NRPYrcs 2-SIGMA DIFFERENCE (m): 0.107
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.263

NRPXrcs 2-RMS DIFFERENCE (m): 0.858
NRPYrcs 2-RMS DIFFERENCE (m): 0.181
NRP Zrcs 2-RMS DIFFERENCE (m): 0.354

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGFP Xrcs POSITION (m): 130.230
LGFP Yrcs POSITION (m): 0.970

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPXrcs MEAN DIFFERENCE (m): 0.415
NRPYrcs MEAN DIFFERENCE (m): -0.073
NRP Zrcs MEAN DIFFERENCE (m): 0.119

NRPXrcs 2-SIGMA DIFFERENCE (m): 0.220
NRPYrcs 2-SIGMA DIFFERENCE (m): 0.107
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.263

NRPXrcs 2-RMS DIFFERENCE (m): 0.858
NRPYrcs 2-RMS DIFFERENCE (m): 0.181
NRP Zrcs 2-RMS DIFFERENCE (m): 0.354

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGFP Xrcs POSITION (m): 130.230
LGFP Yrcs POSITION (m): 0.970
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

-6000 -5000 -4000 -3000 -2000 -1000 0 1000

NRP Xrcs Diff (m)

-6000 -5000 -4000 -3000 -2000 -1000 0 1000

NRP Yrcs Diff (m)

-6000 -5000 -4000 -3000 -2000 -1000 0 1000

NRP Zrcs Diff (m)

-6000 -5000 -4000 -3000 -2000 -1000 0 1000

SU428420
**APPROACH #: SU428422**
**START TIME: 239663.999**
**STOP TIME: 239775.249**

**MINIMUM HDOP: 3.2**
**MAXIMUM HDOP: 3.3**
**AVERAGE HDOP: 3.3**

**MINIMUM VDOP: 5.3**
**MAXIMUM VDOP: 5.3**
**AVERAGE VDOP: 5.3**

**MINIMUM NUMBER OF SVs: 4**
**MAXIMUM NUMBER OF SVs: 4**
**AVERAGE NUMBER OF SVs: 4**

**HDOP:**
- MAXIMUM: 3.3
- AVERAGE: 3.3

**VDOP:**
- MAXIMUM: 5.3
- AVERAGE: 5.3

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

<table>
<thead>
<tr>
<th>Number</th>
<th>Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRP Xrcs</td>
<td>0.499</td>
</tr>
<tr>
<td>NRP Yrcs</td>
<td>-0.103</td>
</tr>
<tr>
<td>NRP Zrcs</td>
<td>0.005</td>
</tr>
<tr>
<td>NRP Xrcs 2-SIGMA</td>
<td>0.251</td>
</tr>
<tr>
<td>NRP Xrcs 2-SIGMA</td>
<td>0.127</td>
</tr>
<tr>
<td>NRP Zrcs 2-SIGMA</td>
<td>0.265</td>
</tr>
<tr>
<td>NRP Xrcs 2-RMS</td>
<td>1.029</td>
</tr>
<tr>
<td>NRP Yrcs 2-RMS</td>
<td>0.243</td>
</tr>
<tr>
<td>NRP Zrcs 2-RMS</td>
<td>0.265</td>
</tr>
</tbody>
</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>Number</th>
<th>Position (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGRP Xrcs</td>
<td>278.237</td>
</tr>
<tr>
<td>LGRP Yrcs</td>
<td>-0.682</td>
</tr>
</tbody>
</table>
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428422

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428424
START TIME: 240104.249
STOP TIME: 240216.499

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.0
AVERAGE HDOP: 3.0

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRX X RCS MEAN DIFFERENCE (m): 0.422
NRX Y RCS MEAN DIFFERENCE (m): -0.053
NRX Z RCS MEAN DIFFERENCE (m): -0.032

NRX X RCS 2-SIGMA DIFFERENCE (m): 0.273
NRX Y RCS 2-SIGMA DIFFERENCE (m): 0.158
NRX Z RCS 2-SIGMA DIFFERENCE (m): 0.219

NRX X RCS 2-RMS DIFFERENCE (m): 0.888
NRX Y RCS 2-RMS DIFFERENCE (m): 0.191
NRX Z RCS 2-RMS DIFFERENCE (m): 0.228

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LRP X RCS POSITION (m): 111.021
LRP Y RCS POSITION (m): -1.754
PATH FOLLOWING ERROR

SU428424

CONTROL MOTION NOISE

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)

SU428424:

-6000 -5000 -4000 -3000 -2000 -1000 0 1000 2000 3000

-6000 -5000 -4000 -3000 -2000 -1000 0 1000 2000 3000

-6000 -5000 -4000 -3000 -2000 -1000 0 1000 2000 3000

NRP Xrcs Position (m)
APPROACH #: SU428426
START TIME: 240510.249
STOP TIME: 240625.749

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.9
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.2
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

*************************************************
* VALID APPROACH *
*************************************************

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.532
NRP Yrcs MEAN DIFFERENCE (m): -0.134
NRP Zrcs MEAN DIFFERENCE (m): 0.094

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.309
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.117
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.211

NRP Xrcs 2-RMS DIFFERENCE (m): 1.107
NRP Yrcs 2-RMS DIFFERENCE (m): 0.415
NRP Zrcs 2-RMS DIFFERENCE (m): 0.282

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 206.503
LGRP Yrcs POSITION (m): 0.040
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

SU428426
APPROACH #: SU428430
START TIME: 241501.749
STOP TIME: 241613.499

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.4
AVERAGE VDOP: 5.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

********************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
********************************************************************************

********************************************************************************
* VALID APPROACH *
********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.497
NRP Yrcs MEAN DIFFERENCE (m): -0.207
NRP Zrcs MEAN DIFFERENCE (m): 0.069

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.316
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.363
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.236

NRP Xrcs 2-RMS DIFFERENCE (m): 1.042
NRP Yrcs 2-RMS DIFFERENCE (m): 0.551
NRP Zrcs 2-RMS DIFFERENCE (m): 0.273

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 214.023
LGRP Yrcs POSITION (m): 0.650

********************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
********************************************************************************

********************************************************************************
* UNSUCCESSFUL APPROACH (NO 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
********************************************************************************

********************************************************************************
* VALID APPROACH *
********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.497
NRP Yrcs MEAN DIFFERENCE (m): -0.207
NRP Zrcs MEAN DIFFERENCE (m): 0.069

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.316
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.363
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.236

NRP Xrcs 2-RMS DIFFERENCE (m): 1.042
NRP Yrcs 2-RMS DIFFERENCE (m): 0.551
NRP Zrcs 2-RMS DIFFERENCE (m): 0.273

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 214.023
LGRP Yrcs POSITION (m): 0.650
APPROACH #: SU428432
START TIME: 241953.999
STOP TIME: 242072.499
MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.9
AVERAGE HDOP: 2.9
MINIMUM VDOP: 5.5
MAXIMUM VDOP: 5.5
AVERAGE VDOP: 5.5
MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***********************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
***********************************************************************

***********************************************************************
* VALID APPROACH *
***********************************************************************

***********************************************************************
* SUCCESSFUL APPROACH *
***********************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.448
NRP Yrcs MEAN DIFFERENCE (m): 0.024
NRP Zrcs MEAN DIFFERENCE (m): 0.054
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.282
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.112
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.293
NRP Xrcs 2-RMS DIFFERENCE (m): 0.939
NRP Yrcs 2-RMS DIFFERENCE (m): 0.122
NRP Zrcs 2-RMS DIFFERENCE (m): 0.312

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGPR Xrcs POSITION (m): 142.172
LGPR Yrcs POSITION (m): 3.233

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.448
NRP Yrcs MEAN DIFFERENCE (m): 0.024
NRP Zrcs MEAN DIFFERENCE (m): 0.054
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.282
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.112
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.293
NRP Xrcs 2-RMS DIFFERENCE (m): 0.939
NRP Yrcs 2-RMS DIFFERENCE (m): 0.122
NRP Zrcs 2-RMS DIFFERENCE (m): 0.312

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGPR Xrcs POSITION (m): 142.172
LGPR Yrcs POSITION (m): 3.233
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)

SU428432
APPROACH #: SU428434
START TIME: 242365.249
STOP TIME: 242481.749

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.0
AVERAGE HDOP: 3.0

MINIMUM VDOP: 5.6
MAXIMUM VDOP: 5.7
AVERAGE VDOP: 5.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*******************************************************************************

*******************************************************************************

* VALID APPROACH *
*******************************************************************************

*******************************************************************************

* SUCCESSFUL APPROACH *
*******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-Out

LGRP Xc (m): 229.074
LGRP Yc (m): -0.939
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

SU428434

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428434:

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428436
START TIME: 242738.249
STOP TIME: 242852.249

MINIMUM HDOP: 3.2
MAXIMUM HDOP: 3.2
AVERAGE HDOP: 3.2

MINIMUM VDOP: 5.9
MAXIMUM VDOP: 6.0
AVERAGE VDOP: 5.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*****************************************************************************
** METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY **
*****************************************************************************

*****************************************************************************
** METHOD OF EVALUATION: SENSOR ACCURACY **
*****************************************************************************

*****************************************************************************
** UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN **
** 95 PERCENT OF ALL OF THE DATA POINTS WITHIN **
** THE VERTICAL FILTER REQUIREMENTS **
*****************************************************************************

*****************************************************************************
** SUCCESSFUL APPROACH **
*****************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRXcs MEAN DIFFERENCE (m): 0.547
NYcs MEAN DIFFERENCE (m): -0.091
NZcs MEAN DIFFERENCE (m): 0.046

NRXcs 2-SIGMA DIFFERENCE (m): 0.303
NYcs 2-SIGMA DIFFERENCE (m): 0.412
NZcs 2-SIGMA DIFFERENCE (m): 0.344

NRXcs 2-RMS DIFFERENCE (m): 1.135
NYcs 2-RMS DIFFERENCE (m): 0.450
NZcs 2-RMS DIFFERENCE (m): 0.357

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRXcs POSITION (m): 206.275
LGRYcs POSITION (m): -0.372
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs Position (m), GPS (.), Truth (-)

NRP Yrcs Tot Sys Diff (m)

NRP -Zrcs Position (m)

NRP -Zrcs Tot Sys Diff (m)
PATH FOLLOWING ERROR

E 20
v
-1
10
O
W
m
-10
I
J
-20
-6000

PATH FOLLOWING ERROR

CONTROL MOTION NOISE

E 20
v
-1
10
O
W
m
-10
I
J
-20
-6000

CONTROL MOTION NOISE

SU428436

111
APPROACH #: SU428438
START TIME: 243149.749
STOP TIME: 243268.999
MINIMUM HDOP: 3.4
MAXIMUM HDOP: 3.5
AVERAGE HDOP: 3.4
MINIMUM VDOP: 6.4
MAXIMUM VDOP: 6.6
AVERAGE VDOP: 6.5
MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.492
NRP Yrcs MEAN DIFFERENCE (m): -0.038
NRP Zrcs MEAN DIFFERENCE (m): -0.061
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.243
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.193
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.284
NRP Xrcs 2-RMS DIFFERENCE (m): 1.014
NRP Yrcs 2-RMS DIFFERENCE (m): 0.208
NRP Zrcs 2-RMS DIFFERENCE (m): 0.309

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 196.259
LGRP Yrcs POSITION (m): -1.026

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.492
NRP Yrcs MEAN DIFFERENCE (m): -0.038
NRP Zrcs MEAN DIFFERENCE (m): -0.061
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.243
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.193
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.284
NRP Xrcs 2-RMS DIFFERENCE (m): 1.014
NRP Yrcs 2-RMS DIFFERENCE (m): 0.208
NRP Zrcs 2-RMS DIFFERENCE (m): 0.309

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 196.259
LGRP Yrcs POSITION (m): -1.026
APPROACH #: SU428440
START TIME: 243585.749
STOP TIME: 243702.999

MINIMUM HDOP: 3.7
MAXIMUM HDOP: 3.7
AVERAGE HDOP: 3.7

MINIMUM VDOP: 7.2
MAXIMUM VDOP: 7.5
AVERAGE VDOP: 7.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRX X RCS MEAN DIFFERENCE (m): 0.557
NRX Y RCS MEAN DIFFERENCE (m): -0.136
NRX Z RCS MEAN DIFFERENCE (m): 0.054

NRX X RCS 2-SIGMA DIFFERENCE (m): 0.325
NRX Y RCS 2-SIGMA DIFFERENCE (m): 0.243
NRX Z RCS 2-SIGMA DIFFERENCE (m): 0.285

NRX X RCS 2-RMS DIFFERENCE (m): 1.161
NRX Y RCS 2-RMS DIFFERENCE (m): 0.364
NRX Z RCS 2-RMS DIFFERENCE (m): 0.304

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGFP X RCS POSITION (m): 195.295
LGFP Y RCS POSITION (m): 0.297
APPROACH #: SU428442
START TIME: 243992.999
STOP TIME: 244106.749

MINIMUM HDOP: 3.9
MAXIMUM HDOP: 4.0
AVERAGE HDOP: 3.9

MINIMUM VDOP: 8.3
MAXIMUM VDOP: 8.6
AVERAGE VDOP: 8.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.554
NRP Yrcs MEAN DIFFERENCE (m): -0.148
NRP Zrcs MEAN DIFFERENCE (m): -0.078

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.369
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.278
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.255

NRP Xrcs 2-RMS DIFFERENCE (m): 1.168
NRP Yrcs 2-RMS DIFFERENCE (m): 0.406
NRP Zrcs 2-RMS DIFFERENCE (m): 0.299

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 156.582
LGRP Yrcs POSITION (m): -0.056

APPROACH #: SU428444
START TIME: 244410.249
STOP TIME: 244526.999

MINIMUM HDOP: 4.1
MAXIMUM HDOP: 4.1
AVERAGE HDOP: 4.1

MINIMUM VDOP: 9.5
MAXIMUM VDOP: 9.7
AVERAGE VDOP: 9.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.545
NRP Yrcs MEAN DIFFERENCE (m): -0.062
NRP Zrcs MEAN DIFFERENCE (m): -0.001

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.333
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.250
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.290

NRP Xrcs 2-RMS DIFFERENCE (m): 1.140
NRP Yrcs 2-RMS DIFFERENCE (m): 0.279
NRP Zrcs 2-RMS DIFFERENCE (m): 0.290

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 205.175
LGRP Yrcs POSITION (m): -2.959
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

SU428444

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)

SU428444:

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428446
START TIME: 244827.999
STOP TIME: 244944.249

MINIMUM HDOP: 3.2
MAXIMUM HDOP: 3.2
AVERAGE HDOP: 3.2

MINIMUM VDOP: 10.3
MAXIMUM VDOP: 10.4
AVERAGE VDOP: 10.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPX MEAN DIFFERENCE (m): 0.562
NRPY MEAN DIFFERENCE (m): -0.209
NRNZ MEAN DIFFERENCE (m): 0.123

NRPX 2-SIGMA DIFFERENCE (m): 0.423
NRPY 2-SIGMA DIFFERENCE (m): 0.362
NRNZ 2-SIGMA DIFFERENCE (m): 0.361

NRPX 2-RMS DIFFERENCE (m): 1.202
NRPY 2-RMS DIFFERENCE (m): 0.553
NRNZ 2-RMS DIFFERENCE (m): 0.436

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP XPOS (m): 151.191
LGRP YPOS (m): 3.015
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Yrcs Total Sys Diff (m)

NRP Zrcs Position (m)

NRP Zrcs Total Sys Diff (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428446

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428448
START TIME: 245219.999
STOP TIME: 245342.249

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.1

MINIMUM VDOP: 10.1
MAXIMUM VDOP: 10.3
AVERAGE VDOP: 10.2

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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  VALID APPROACH
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  SUCCESSFUL APPROACH
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRX MEAN DIFFERENCE (m): 0.514
NRY MEAN DIFFERENCE (m): -0.185
NZ MEAN DIFFERENCE (m): 0.212

NRX 2-SIGMA DIFFERENCE (m): 0.262
NRY 2-SIGMA DIFFERENCE (m): 0.298
NZ 2-SIGMA DIFFERENCE (m): 0.191

NRX 2-RMS DIFFERENCE (m): 1.061
NRY 2-RMS DIFFERENCE (m): 0.475
NZ 2-RMS DIFFERENCE (m): 0.466

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LRX MEAN POSITION (m): 297.099
LRY MEAN POSITION (m): 0.099

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LRX MEAN POSITION (m): 297.099
LRY MEAN POSITION (m): 0.099
PATH FOLLOWING ERROR

SU428448

CONTROL MOTION NOISE
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

SU428448:

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428452
START TIME: 246565.499
STOP TIME: 246679.499

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 6.7
MAXIMUM VDOP: 7.0
AVERAGE VDOP: 6.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.496
NRP Yrcs MEAN DIFFERENCE (m): -0.175
NRP Zrcs MEAN DIFFERENCE (m): -0.050

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.264
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.250
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.347

NRP Xrcs 2-RMS DIFFERENCE (m): 1.027
NRP Yrcs 2-RMS DIFFERENCE (m): 0.431
NRP Zrcs 2-RMS DIFFERENCE (m): 0.361

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 144.629
LGRP Yrcs POSITION (m): 0.942
APPROACH #: SU428454
START TIME: 246991.999
STOP TIME: 247104.999

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 5.7
MAXIMUM VDOP: 5.9
AVERAGE VDOP: 5.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* METHOD OF EVALUATION: SENSOR ACCURACY *
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* UNSUCCESSFUL APPROACH (MDS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN  *
* THE VERTICAL FILTER REQUIREMENTS  *
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* VALID APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
--------------------------------------------------------
NRP Xrcs MEAN DIFFERENCE (m): 0.385
NRP Yrcs MEAN DIFFERENCE (m): -0.234
NRP Zrcs MEAN DIFFERENCE (m): 0.067

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.245
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.289
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.248

NRP Xrcs 2-RMS DIFFERENCE (m): 0.807
NRP Yrcs 2-RMS DIFFERENCE (m): 0.550
NRP Zrcs 2-RMS DIFFERENCE (m): 0.281

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
--------------------------------------------------------
LGRP Xrcs POSITION (m): 81.102
LGRP Yrcs POSITION (m): 2.946
APPROACH #: SU428456
START TIME: 247426.749
STOP TIME: 247542.249

MINIMUM HEO: 2.5
MAXIMUM HEO: 2.5
AVERAGE HEO: 2.5

MINIMUM VDOP: 4.7
MAXIMUM VDOP: 5.0
AVERAGE VDOP: 4.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* METHOD OF EVALUATION: SENSOR ACCURACY *
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*****************************************************************************
* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
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* VALID APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.462
NRP Yrcs MEAN DIFFERENCE (m): -0.135
NRP Zrcs MEAN DIFFERENCE (m): 0.003

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.370
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.215
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.272

NRP Xrcs 2-RMS DIFFERENCE (m): 0.995
NRP Yrcs 2-RMS DIFFERENCE (m): 0.345
NRP Zrcs 2-RMS DIFFERENCE (m): 0.272

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 170.414
LGRP Yrcs POSITION (m): 1.619

APPROACH #: SU428456
START TIME: 247426.749
STOP TIME: 247542.249

MINIMUM HEO: 2.5
MAXIMUM HEO: 2.5
AVERAGE HEO: 2.5

MINIMUM VDOP: 4.7
MAXIMUM VDOP: 5.0
AVERAGE VDOP: 4.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: SENSOR ACCURACY *
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*****************************************************************************
* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
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* VALID APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.462
NRP Yrcs MEAN DIFFERENCE (m): -0.135
NRP Zrcs MEAN DIFFERENCE (m): 0.003

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.370
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.215
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.272

NRP Xrcs 2-RMS DIFFERENCE (m): 0.995
NRP Yrcs 2-RMS DIFFERENCE (m): 0.345
NRP Zrcs 2-RMS DIFFERENCE (m): 0.272

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 170.414
LGRP Yrcs POSITION (m): 1.619
APPROACH #: SU428458
START TIME: 247845.999
STOP TIME: 247959.749

MINIMUM HDOP: 1.9
MAXIMUM HDOP: 2.0
AVERAGE HDOP: 1.9

MINIMUM VDOP: 3.6
MAXIMUM VDOP: 3.7
AVERAGE VDOP: 3.7

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY
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* VALID APPROACH *

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METHOD OF EVALUATION: SENSOR ACCURACY
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* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN THE VERTICAL FILTER REQUIREMENTS *

* VALID APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.513
NRP Yrcs MEAN DIFFERENCE (m): -0.123
NRP Zrcs MEAN DIFFERENCE (m): 0.056

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.337
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.151
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.288

NRP Xrcs 2-RMS DIFFERENCE (m): 1.079
NRP Yrcs 2-RMS DIFFERENCE (m): 0.289
NRP Zrcs 2-RMS DIFFERENCE (m): 0.309

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 194.833
LGRP Yrcs POSITION (m): 1.500
PATH FOLLOWING ERROR

SU428458

CONTROL MOTION NOISE

NRP Xrcs Position (m)
APPROACH #: SU428460
START TIME: 248254.249
STOP TIME: 248370.249

MINIMUM HDOP: 2.1
MAXIMUM HDOP: 2.1
AVERAGE HDOP: 2.1

MINIMUM VDOP: 3.4
MAXIMUM VDOP: 3.5
AVERAGE VDOP: 3.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.516
NRP Yrcs MEAN DIFFERENCE (m): 0.022
NRP Zrcs MEAN DIFFERENCE (m): 0.008

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.179
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.129
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.282

NRP Xrcs 2-RMS DIFFERENCE (m): 1.047
NRP Yrcs 2-RMS DIFFERENCE (m): 0.137
NRP Zrcs 2-RMS DIFFERENCE (m): 0.282

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 256.232
LGRP Yrcs POSITION (m): 0.259

********************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
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********************************************************************
* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
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********************************************************************
* VALID APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.516
NRP Yrcs MEAN DIFFERENCE (m): 0.022
NRP Zrcs MEAN DIFFERENCE (m): 0.008

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.179
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.129
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.282

NRP Xrcs 2-RMS DIFFERENCE (m): 1.047
NRP Yrcs 2-RMS DIFFERENCE (m): 0.137
NRP Zrcs 2-RMS DIFFERENCE (m): 0.282

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 256.232
LGRP Yrcs POSITION (m): 0.259

153
APPROACH #: SU428462
START TIME: 248668.249
STOP TIME: 248781.999

MINIMUM HDOP: 5.5
MAXIMUM HDOP: 6.4
AVERAGE HDOP: 5.9

MINIMUM VDOP: 13.2
MAXIMUM VDOP: 15.9
AVERAGE VDOP: 14.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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******************************************************************************
* VALID APPROACH *
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******************************************************************************
* SUCCESSFUL APPROACH *
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TIMHISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.617
NRP Yrcs MEAN DIFFERENCE (m): -0.334
NRP Zrcs MEAN DIFFERENCE (m): 0.031

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.403
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.571
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.277

NRP Xrcs 2-RMS DIFFERENCE (m): 1.298
NRP Yrcs 2-RMS DIFFERENCE (m): 0.879
NRP Zrcs 2-RMS DIFFERENCE (m): 0.284

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 190.189
LGRP Yrcs POSITION (m): 3.431
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428464
START TIME: 249107.749
STOP TIME: 249227.499

MINIMUM HDOP: 3.7
MAXIMUM HDOP: 4.0
AVERAGE HDOP: 3.9

MINIMUM VDOP: 8.0
MAXIMUM VDOP: 8.9
AVERAGE VDOP: 8.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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******************************************************************************
* VALID APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.422
NRP Yrcs MEAN DIFFERENCE (m): -0.232
NRP Zrcs MEAN DIFFERENCE (m): 0.087

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.215
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.363
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.228

NRP Xrcs 2-RMS DIFFERENCE (m): 0.870
NRP Yrcs 2-RMS DIFFERENCE (m): 0.590
NRP Zrcs 2-RMS DIFFERENCE (m): 0.286

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 318.170
LGRP Yrcs POSITION (m): 0.668

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* METHOD OF EVALUATION: SENSOR ACCURACY *
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* UNSUCCESSFUL APPROACH (NO 1) DUE TO LESS THAN * 95 PERCENT OF ALL THE DATA POINTS WITHIN * THE VERTICAL FILTER REQUIREMENTS *
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******************************************************************************
* VALID APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.422
NRP Yrcs MEAN DIFFERENCE (m): -0.232
NRP Zrcs MEAN DIFFERENCE (m): 0.087

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.215
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.363
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.228

NRP Xrcs 2-RMS DIFFERENCE (m): 0.870
NRP Yrcs 2-RMS DIFFERENCE (m): 0.590
NRP Zrcs 2-RMS DIFFERENCE (m): 0.286

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 318.170
LGRP Yrcs POSITION (m): 0.668
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs Position (m), Truth

NRP Yrcs Tot Sys Diff (m)

NRP Zrcs Position (m)

NRP Zrcs Tot Sys Diff (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428464:

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428466
START TIME: 249554.749
STOP TIME: 249673.749

MINIMUM HDOP: 3.1
MAXIMUM HDOP: 3.2
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.8
MAXIMUM VDOP: 6.3
AVERAGE VDOP: 6.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

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* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
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* VALID APPROACH *
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* SUCCESSFUL APPROACH *
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TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.493
NRP Yrcs MEAN DIFFERENCE (m): -0.111
NRP Zrcs MEAN DIFFERENCE (m): 0.099

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.176
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.144
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.259

NRP Xrcs 2-RMS DIFFERENCE (m): 0.981
NRP Yrcs 2-RMS DIFFERENCE (m): 0.264
NRP Zrcs 2-RMS DIFFERENCE (m): 0.326

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 290.855
LGRP Yrcs POSITION (m): 3.532
APPROACH #: SU428468
START TIME: 249979.749
STOP TIME: 250099.749

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.9
AVERAGE HDOP: 2.9

MINIMUM VDOP: 4.8
MAXIMUM VDOP: 5.0
AVERAGE VDOP: 4.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.514
NRP Yrcs MEAN DIFFERENCE (m): -0.212
NRP Zrcs MEAN DIFFERENCE (m): -0.004

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.247
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.405
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.312

NRP Xrcs 2-RMS DIFFERENCE (m): 1.058
NRP Yrcs 2-RMS DIFFERENCE (m): 0.587
NRP Zrcs 2-RMS DIFFERENCE (m): 0.312

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 161.687
LGRP Yrcs POSITION (m): -0.457
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428468:

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428470
START TIME: 250402.749
STOP TIME: 250522.499

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 4.2
MAXIMUM VDOP: 4.3
AVERAGE VDOP: 4.2

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*******************************************************************************

*******************************************************************************
* VALID APPROACH *
*******************************************************************************

*******************************************************************************
* SUCCESSFUL APPROACH *
*******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.538
NRP Yrcs MEAN DIFFERENCE (m): -0.155
NRP Zrcs MEAN DIFFERENCE (m): 0.081

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.373
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.222
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.252

NRP Xrcs 2-RMS DIFFERENCE (m): 1.139
NRP Yrcs 2-RMS DIFFERENCE (m): 0.381
NRP Zrcs 2-RMS DIFFERENCE (m): 0.300

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 129.115
LGRP Yrcs POSITION (m): 0.682

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 129.115
LGRP Yrcs POSITION (m): 0.682
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Vertical PFE Filter Output (m)

-6000 -4000 -2000 0

Vertical CMN Filter Output (m)

-6000 -4000 -2000 0

Lateral PFE Filter Output (m)

-6000 -4000 -2000 0

Lateral CMN Filter Output (m)

-6000 -4000 -2000 0
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)

SU428470
APPROACH #: SU428502
START TIME: 321140.624
STOP TIME: 321247.249

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.7
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.1
MAXIMUM VDOP: 5.1
AVERAGE VDOP: 5.1

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*********************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*********************************************************************************

*********************************************************************************
* VALID APPROACH *
*********************************************************************************

*********************************************************************************
* SUCCESSFUL APPROACH *
*********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.434
NRP Yrcs MEAN DIFFERENCE (m): -0.256
NRP Zrcs MEAN DIFFERENCE (m): 0.062
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.370
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.383
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.200
NRP Xrcs 2-RMS DIFFERENCE (m): 0.944
NRP Yrcs 2-RMS DIFFERENCE (m): 0.639
NRP Zrcs 2-RMS DIFFERENCE (m): 0.259

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 85.159
LGRP Yrcs POSITION (m): 1.071
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)
APPROACH #: SU428504
START TIME: 321575.249
STOP TIME: 321683.999

MINIMUM HDOP: 2.6
MAXIMUM HDOP: 2.6
AVERAGE HDOP: 2.6

MINIMUM VDOP: 4.9
MAXIMUM VDOP: 4.9
AVERAGE VDOP: 4.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *

* VALID APPROACH *

* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.299
NRP Yrcs MEAN DIFFERENCE (m): -0.063
NRP Zrcs MEAN DIFFERENCE (m): 0.104

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.167
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.131
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.220

NRP Xrcs 2-RMS DIFFERENCE (m): 0.620
NRP Yrcs 2-RMS DIFFERENCE (m): 0.182
NRP Zrcs 2-RMS DIFFERENCE (m): 0.303

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 167.032
LGRP Yrcs POSITION (m): 0.068
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

SU428504

NRP Xrcs Position (m)

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
**APPROACH #: SU428506**
START TIME: 322268.999
STOP TIME: 322376.499

<table>
<thead>
<tr>
<th>MINIMUM HOOP: 2.4</th>
<th>MAXIMUM HOOP: 2.4</th>
<th>AVERAGE HOOP: 2.4</th>
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<tbody>
<tr>
<td>MINIMUM VDOP: 4.3</td>
<td>MAXIMUM VDOP: 4.4</td>
<td>AVERAGE VDOP: 4.3</td>
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</table>

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

**METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY**

**APPROACH #: SU428506**
START TIME: 322268.999
STOP TIME: 322376.499

<table>
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<tr>
<th>MINIMUM HOOP: 2.4</th>
<th>MAXIMUM HOOP: 2.4</th>
<th>AVERAGE HOOP: 2.4</th>
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</thead>
<tbody>
<tr>
<td>MINIMUM VDOP: 4.3</td>
<td>MAXIMUM VDOP: 4.4</td>
<td>AVERAGE VDOP: 4.3</td>
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MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

**METHOD OF EVALUATION: SENSOR ACCURACY**

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

<table>
<thead>
<tr>
<th>NRP Xrcs MEAN DIFFERENCE (m)</th>
<th>NRP Yrcs MEAN DIFFERENCE (m)</th>
<th>NRP Zrcs MEAN DIFFERENCE (m)</th>
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</thead>
<tbody>
<tr>
<td>0.452</td>
<td>-0.204</td>
<td>0.251</td>
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<tr>
<th>NRP Xrcs 2-SIGMA DIFFERENCE (m)</th>
<th>NRP Yrcs 2-SIGMA DIFFERENCE (m)</th>
<th>NRP Zrcs 2-SIGMA DIFFERENCE (m)</th>
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<tbody>
<tr>
<td>0.239</td>
<td>0.173</td>
<td>0.292</td>
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<table>
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<tr>
<th>NRP Xrcs 2-RMS DIFFERENCE (m)</th>
<th>NRP Yrcs 2-RMS DIFFERENCE (m)</th>
<th>NRP Zrcs 2-RMS DIFFERENCE (m)</th>
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<tbody>
<tr>
<td>0.935</td>
<td>0.444</td>
<td>0.580</td>
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LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

<table>
<thead>
<tr>
<th>LGRP Xrcs POSITION (m)</th>
<th>LGRP Yrcs POSITION (m)</th>
<th>LGRP Zrcs POSITION (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>133.697</td>
<td>1.379</td>
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NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

SU428506

NRP Xrcs Position (m)
APPROACH #: SU428508
START TIME: 322668.999
STOP TIME: 322777.249

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 3.9
MAXIMUM VDOP: 4.0
AVERAGE VDOP: 4.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*******************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*******************************

*******************************
* VALID APPROACH *
*******************************

*******************************
* SUCCESSFUL APPROACH *
*******************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.472
NRP Yrcs MEAN DIFFERENCE (m): -0.138
NRP Zrcs MEAN DIFFERENCE (m): 0.138

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.240
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.158
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.248

NRP Xrcs 2-RMS DIFFERENCE (m): 0.974
NRP Yrcs 2-RMS DIFFERENCE (m): 0.318
NRP Zrcs 2-RMS DIFFERENCE (m): 0.371

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 115.686
LGRP Yrcs POSITION (m): -0.934
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428508

NRP Xrcs Position (m)
APPROACH #: SU428510
START TIME: 323056.999
STOP TIME: 323165.749

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 3.7
MAXIMUM VDOP: 3.7
AVERAGE VDOP: 3.7

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean Difference (m)</th>
<th>2-Sigma Difference (m)</th>
<th>2-RMS Difference (m)</th>
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<tbody>
<tr>
<td>NRP Xrcs</td>
<td>0.440</td>
<td>0.140</td>
<td>0.891</td>
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<tr>
<td>NRP Yrcs</td>
<td>-0.211</td>
<td>0.199</td>
<td>0.466</td>
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<tr>
<td>NRP Zrcs</td>
<td>0.082</td>
<td>0.232</td>
<td>0.283</td>
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<tr>
<td>LGRP Xrcs</td>
<td>162.269</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LGRP Yrcs</td>
<td>-3.032</td>
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</table>

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Position (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGRP Xrcs</td>
<td>162.269</td>
</tr>
<tr>
<td>LGRP Yrcs</td>
<td>-3.032</td>
</tr>
</tbody>
</table>
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

NRP Xrcs Position (m)
APPROACH #: SU428512
START TIME: 323478.749
STOP TIME: 323587.499

MINIMUM HDOP: 2.2
MAXIMUM HDOP: 2.2
AVERAGE HDOP: 2.2

MINIMUM VDOP: 3.5
MAXIMUM VDOP: 3.5
AVERAGE VDOP: 3.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *

* VALID APPROACH *

* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.349
NRP Yrcs MEAN DIFFERENCE (m): -0.240
NRP Zrcs MEAN DIFFERENCE (m): 0.000

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.215
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.378
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.172

NRP Xrcs 2-RMS DIFFERENCE (m): 0.730
NRP Yrcs 2-RMS DIFFERENCE (m): 0.611
NRP Zrcs 2-RMS DIFFERENCE (m): 0.172

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 139.993
LGRP Yrcs POSITION (m): 3.610
APPROACH #: SU428516
START TIME: 324269.749
STOP TIME: 324378.749
MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4
MINIMUM VDOP: 4.5
MAXIMUM VDOP: 4.6
AVERAGE VDOP: 4.5
MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

**************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
**************************************************************

**************************************************************
* VALID APPROACH *
**************************************************************

**************************************************************
* SUCCESSFUL APPROACH *
**************************************************************

TIE HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
*****************************************************
NRP Xrcs MEAN DIFFERENCE (m): 0.379
NRP Yrcs MEAN DIFFERENCE (m): -0.127
NRP Zrcs MEAN DIFFERENCE (m): 0.039
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.171
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.198
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.208
NRP Xrcs 2-RMS DIFFERENCE (m): 0.777
NRP Yrcs 2-RMS DIFFERENCE (m): 0.322
NRP Zrcs 2-RMS DIFFERENCE (m): 0.222

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
***************************************************
LGRP Xrcs POSITION (m): 217.611
LGRP Yrcs POSITION (m): -1.285
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428518
START TIME: 324661.249
STOP TIME: 324770.249

MINIMUM HDOP: 2.5
MAXIMUM HDOP: 2.5
AVERAGE HDOP: 2.5

MINIMUM VDOP: 4.8
MAXIMUM VDOP: 4.9
AVERAGE VDOP: 4.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

********************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
********************************************

* VALID APPROACH *

********************************************
* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.370
NRP Yrcs MEAN DIFFERENCE (m): -0.048
NRP Zrcs MEAN DIFFERENCE (m): 0.057
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.225
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.087
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.202
NRP Xrcs 2-RMS DIFFERENCE (m): 0.773
NRP Yrcs 2-RMS DIFFERENCE (m): 0.130
NRP Zrcs 2-RMS DIFFERENCE (m): 0.231

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 193.498
LGRP Yrcs POSITION (m): -0.409
PATH FOLLOWING ERROR

SU428518

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428520
START TIME: 325118.749
STOP TIME: 325227.749

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.7
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.2
MAXIMUM VDOP: 5.4
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***********************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
***********************************************************************

*********************************************************************************
* VALID APPROACH *
*********************************************************************************

*********************************************************************************
* SUCCESSFUL APPROACH *
*********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.365
NRP Yrcs MEAN DIFFERENCE (m): -0.037
NRP Zrcs MEAN DIFFERENCE (m): -0.032

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.313
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.224
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.207

NRP Xrcs 2-RMS DIFFERENCE (m): 0.795
NRP Yrcs 2-RMS DIFFERENCE (m): 0.236
NRP Zrcs 2-RMS DIFFERENCE (m): 0.216

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 242.966
LGRP Yrcs POSITION (m): 2.444
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Vertical PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical CMN Filter Output (m)

SU428520
APPROACH #: SU428522
START TIME: 325549.749
STOP TIME: 325659.499

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.0

MINIMUM VDOP: 5.9
MAXIMUM VDOP: 6.1
AVERAGE VDOP: 6.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************
METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY
******************************

******************************
VALID APPROACH
******************************

******************************
SUCCESSFUL APPROACH
******************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.422
NRP Yrcs MEAN DIFFERENCE (m): -0.091
NRP Zrcs MEAN DIFFERENCE (m): -0.063

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.532
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.132
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.228

NRP Xrcs 2-RMS DIFFERENCE (m): 0.998
NRP Yrcs 2-RMS DIFFERENCE (m): 0.224
NRP Zrcs 2-RMS DIFFERENCE (m): 0.261

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 202.492
LGRP Yrcs POSITION (m): 0.056
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428524
START TIME: 325972.999
STOP TIME: 326087.749

MINIMUM HDOP: 3.1
MAXIMUM HDOP: 3.2
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*****************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*****************************************************************

*****************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*****************************************************************

*****************************************************************
* UNSUCCESSFUL APPROACH (MDS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN VERTICAL FILTER REQUIREMENTS *
*****************************************************************

*****************************************************************
* SUCCESSFUL APPROACH *
*****************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.388
NRP Xrcs MEAN DIFFERENCE (m): 0.056
NRP Zrcs MEAN DIFFERENCE (m): 0.015
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.299
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.173
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.234
NRP Xrcs 2-RMS DIFFERENCE (m): 0.831
NRP Yrcs 2-RMS DIFFERENCE (m): 0.206
NRP Zrcs 2-RMS DIFFERENCE (m): 0.236

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 234.433
LGRP Yrcs POSITION (m): 2.021
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)
APPROACH #: SU428526
START TIME: 326676.999
STOP TIME: 326784.499

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.2
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.467
NRP Xrcs MEAN DIFFERENCE (m): -0.131
NRP Zrcs MEAN DIFFERENCE (m): 0.055

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.193
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.159
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.200

NRP Xrcs 2-RMS DIFFERENCE (m): 0.953
NRP Yrcs 2-RMS DIFFERENCE (m): 0.306
NRP Zrcs 2-RMS DIFFERENCE (m): 0.229

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 228.619
LGRP Yrcs POSITION (m): 3.873
APPROACH #: SU428528
START TIME: 327121.499
STOP TIME: 327229.249

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

********************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
********************************************************************************

********************************************************************************
* VALID APPROACH *
********************************************************************************

********************************************************************************
* SUCCESSFUL APPROACH *
********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
________________________________________________________
NRP Xrcs MEAN DIFFERENCE (m): 0.452
NRP Yrcs MEAN DIFFERENCE (m): -0.113
NRP Zrcs MEAN DIFFERENCE (m): 0.045

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.259
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.161
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.261

NRP Xrcs 2-RMS DIFFERENCE (m): 0.939
NRP Yrcs 2-RMS DIFFERENCE (m): 0.277
NRP Zrcs 2-RMS DIFFERENCE (m): 0.276

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
________________________________________________
LGRP Xrcs POSITION (m): 159.472
LGRP Yrcs POSITION (m): 0.436

********************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
********************************************************************************

********************************************************************************
* UNSUCCESSFUL APPROACH (MOD 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
********************************************************************************

********************************************************************************
* VALID APPROACH *
********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
________________________________________________________
NRP Xrcs MEAN DIFFERENCE (m): 0.452
NRP Yrcs MEAN DIFFERENCE (m): -0.113
NRP Zrcs MEAN DIFFERENCE (m): 0.045

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.259
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.161
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.261

NRP Xrcs 2-RMS DIFFERENCE (m): 0.939
NRP Yrcs 2-RMS DIFFERENCE (m): 0.277
NRP Zrcs 2-RMS DIFFERENCE (m): 0.276

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
________________________________________________
LGRP Xrcs POSITION (m): 159.472
LGRP Yrcs POSITION (m): 0.436

PATH FOLLOWING ERROR

CONTROL MOTION NOISE

SU428528
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)
APPROACH #: SU428530
START TIME: 327545.499
STOP TIME: 327653.249

MINIMUM DHOP: 2.7
MAXIMUM HDOP: 2.7
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

************************************************************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
************************************************************************************************************************

************************************************************************************************************************
* VALID APPROACH *
************************************************************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
-----------------------------------------------------

NRP Xrcs MEAN DIFFERENCE (m): 0.470
NRP Yrcs MEAN DIFFERENCE (m): -0.065
NRP Zrcs MEAN DIFFERENCE (m): 0.007

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.263
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.126
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.180

NRP Xrcs 2-RMS DIFFERENCE (m): 0.976
NRP Yrcs 2-RMS DIFFERENCE (m): 0.180
NRP Zrcs 2-RMS DIFFERENCE (m): 0.181

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
-----------------------------------------------------

LGRP Xrcs POSITION (m): 163.649
LGRP Yrcs POSITION (m): -1.566

APPROACH #: SU428530
START TIME: 327545.499
STOP TIME: 327653.249

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.7
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

************************************************************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
************************************************************************************************************************

************************************************************************************************************************
* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
************************************************************************************************************************

************************************************************************************************************************
* VALID APPROACH *
************************************************************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
-----------------------------------------------------

NRP Xrcs MEAN DIFFERENCE (m): 0.470
NRP Yrcs MEAN DIFFERENCE (m): -0.065
NRP Zrcs MEAN DIFFERENCE (m): 0.007

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.263
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.126
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.180

NRP Xrcs 2-RMS DIFFERENCE (m): 0.976
NRP Yrcs 2-RMS DIFFERENCE (m): 0.180
NRP Zrcs 2-RMS DIFFERENCE (m): 0.181

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
-----------------------------------------------------

LGRP Xrcs POSITION (m): 163.649
LGRP Yrcs POSITION (m): -1.566
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Yrcs Position (m) vs. NRP Xrcs Position (m)

NRP Yrcs Tot Sys Diff (m)

SU428530

NRP -Zrcs (m) vs. NRP Xrcs Position (m)

NRP -Zrcs Tot Sys Diff (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)
APPROACH #: SU428532
START TIME: 327973.249
STOP TIME: 328082.249

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.4
MAXIMUM VDOP: 5.5
AVERAGE VDOP: 5.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

*************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*************************************************

*************************************************
* VALID APPROACH *
*************************************************

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.540
NRP Yrcs MEAN DIFFERENCE (m): -0.022
NKP Zrcs MEAN DIFFERENCE (m): -0.016

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.202
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.132
NKP Zrcs 2-SIGMA DIFFERENCE (m): 0.180

NRP Xrcs 2-RMS DIFFERENCE (m): 1.099
NRP Yrcs 2-RMS DIFFERENCE (m): 0.139
NKP Zrcs 2-RMS DIFFERENCE (m): 0.183

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 170.224
LGRP Yrcs POSITION (m): -0.266

APPROACH #: SU428532
START TIME: 327973.249
STOP TIME: 328082.249

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.4
MAXIMUM VDOP: 5.5
AVERAGE VDOP: 5.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

*************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*************************************************

*************************************************
* VALID APPROACH *
*************************************************

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.540
NRP Yrcs MEAN DIFFERENCE (m): -0.022
NKP Zrcs MEAN DIFFERENCE (m): -0.016

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.202
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.132
NKP Zrcs 2-SIGMA DIFFERENCE (m): 0.180

NRP Xrcs 2-RMS DIFFERENCE (m): 1.099
NRP Yrcs 2-RMS DIFFERENCE (m): 0.139
NKP Zrcs 2-RMS DIFFERENCE (m): 0.183

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 170.224
LGRP Yrcs POSITION (m): -0.266
APPROACH #: SU428534
START TIME: 328379.499
STOP TIME: 328486.999

MINIMUM HDOP: 2.9
MAXIMUM HDOP: 3.0
AVERAGE HDOP: 2.9

MINIMUM VDOP: 5.5
MAXIMUM VDOP: 5.6
AVERAGE VDOP: 5.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*******************************************************************************
*  METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY  *
*******************************************************************************

*******************************************************************************
*  METHOD OF EVALUATION: SENSOR ACCURACY  *
*******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs  MEAN DIFFERENCE (m): 0.594
NRP Yrcs  MEAN DIFFERENCE (m): 0.052
NRP Zrcs  MEAN DIFFERENCE (m): 0.070

NRP Xrcs  2-SIGMA DIFFERENCE (m): 0.186
NRP Yrcs  2-SIGMA DIFFERENCE (m): 0.145
NRP Zrcs  2-SIGMA DIFFERENCE (m): 0.182

NRP Xrcs  2-RMS DIFFERENCE (m): 1.202
NRP Yrcs  2-RMS DIFFERENCE (m): 0.179
NRP Zrcs  2-RMS DIFFERENCE (m): 0.230

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 212.295
LGRP Yrcs POSITION (m): 3.422
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

SU428534

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428536
START TIME: 328798.749
STOP TIME: 328905.499

MINIMUM HDOP: 3.1
MAXIMUM HDOP: 3.2
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.8
MAXIMUM VDOP: 5.9
AVERAGE VDOP: 5.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
* VALID APPROACH *
* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.515
NRP Yrcs MEAN DIFFERENCE (m): -0.145
NRP Zrcs MEAN DIFFERENCE (m): -0.056

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.177
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.187
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.175

NRP Xrcs 2-RMS DIFFERENCE (m): 1.044
NRP Yrcs 2-RMS DIFFERENCE (m): 0.346
NRP Zrcs 2-RMS DIFFERENCE (m): 0.208

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 187.576
LGRP Yrcs POSITION (m): 1.400
PATH FOLLOWING ERROR

Lateral PFE Filter Output (m)

SU428536

NRP Xrcs Position (m)

CONTROL MOTION NOISE

Lateral CMN Filter Output (m)

Lateral CMN Filter Output (m)

NRP Xrcs Position (m)
APPROACH #: SU428538
START TIME: 329209.999
STOP TIME: 329316.499

MINIMUM HDOP: 3.4
MAXIMUM HDOP: 3.4
AVERAGE HDOP: 3.4

MINIMUM VDOP: 6.2
MAXIMUM VDOP: 6.4
AVERAGE VDOP: 6.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
***************************************************************

* VALID APPROACH *

***************************************************************
* SUCCESSFUL APPROACH *

***************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPXrcs MEAN DIFFERENCE (m): 0.494
NRPYrcs MEAN DIFFERENCE (m): -0.140
NRNZrcs MEAN DIFFERENCE (m): -0.050

NRPXrcs 2-SIGMA DIFFERENCE (m): 0.259
NRPYrcs 2-SIGMA DIFFERENCE (m): 0.281
NRNZrcs 2-SIGMA DIFFERENCE (m): 0.212

NRPXrcs 2-RMS DIFFERENCE (m): 1.022
NRPYrcs 2-RMS DIFFERENCE (m): 0.397
NRNZrcs 2-RMS DIFFERENCE (m): 0.235

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRPXrcs POSITION (m): 162.387
LGRPYrcs POSITION (m): -2.614

***************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
***************************************************************

* VALID APPROACH *

***************************************************************
* SUCCESSFUL APPROACH *

***************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPXrcs MEAN DIFFERENCE (m): 0.494
NRPYrcs MEAN DIFFERENCE (m): -0.140
NRNZrcs MEAN DIFFERENCE (m): -0.050

NRPXrcs 2-SIGMA DIFFERENCE (m): 0.259
NRPYrcs 2-SIGMA DIFFERENCE (m): 0.281
NRNZrcs 2-SIGMA DIFFERENCE (m): 0.212

NRPXrcs 2-RMS DIFFERENCE (m): 1.022
NRPYrcs 2-RMS DIFFERENCE (m): 0.397
NRNZrcs 2-RMS DIFFERENCE (m): 0.235

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRPXrcs POSITION (m): 162.387
LGRPYrcs POSITION (m): -2.614
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428538

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428540
START TIME: 329628.249
STOP TIME: 329734.249

MINIMUM HDOP: 3.6
MAXIMUM HDOP: 3.7
AVERAGE HDOP: 3.6

MINIMUM VDOP: 7.0
MAXIMUM VDOP: 7.2
AVERAGE VDOP: 7.1

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.490
NRP Yrcs MEAN DIFFERENCE (m): -0.056
NRP Zrcs MEAN DIFFERENCE (m): 0.042

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.422
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.109
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.192

NRP Xrcs 2-RMS DIFFERENCE (m): 1.068
NRP Yrcs 2-RMS DIFFERENCE (m): 0.157
NRP Zrcs 2-RMS DIFFERENCE (m): 0.210

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 153.001
LGRP Yrcs POSITION (m): -0.893
### APPROACH #: SU428542

**Start Time:** 330027.749

**Stop Time:** 330137.249

**Minimum HDOP:** 3.8

**Maximum HDOP:** 3.9

**Average HDOP:** 3.9

**Minimum VDOP:** 8.0

**Maximum VDOP:** 8.3

**Average VDOP:** 8.1

**Minimum Number of SVs:** 4

**Maximum Number of SVs:** 4

**Average Number of SVs:** 4

---

**Time History Analysis From 200 ft Hat -> Roll-Out**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Mean Difference (m)</th>
<th>2-Sigma Difference (m)</th>
<th>2-RMS Difference (m)</th>
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</thead>
<tbody>
<tr>
<td>NRP Xrcs</td>
<td>0.521</td>
<td>0.405</td>
<td>1.117</td>
</tr>
<tr>
<td>NRP Yrcs</td>
<td>-0.036</td>
<td>0.196</td>
<td>0.209</td>
</tr>
<tr>
<td>NRP Zrcs</td>
<td>0.059</td>
<td>0.196</td>
<td>0.317</td>
</tr>
</tbody>
</table>

**Landing Gear Reference Point Touchdown Position**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Position (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGRP Xrcs</td>
<td>95.967</td>
</tr>
<tr>
<td>LGRP Yrcs</td>
<td>0.325</td>
</tr>
</tbody>
</table>
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428544
START TIME: 331091.999
STOP TIME: 331206.749

MINIMUM HDOP: 3.2
MAXIMUM HDOP: 3.2
AVERAGE HDOP: 3.2
MINIMUM VDOP: 10.4
MAXIMUM VDOP: 10.4
AVERAGE VDOP: 10.4
MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *

* VALID APPROACH *

* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.602
NRP Yrcs MEAN DIFFERENCE (m): 0.253
NRP Zrcs MEAN DIFFERENCE (m): 0.249
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.377
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.241
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.312
NRP Xrcs 2-RMS DIFFERENCE (m): 1.261
NRP Yrcs 2-RMS DIFFERENCE (m): 0.560
NRP Zrcs 2-RMS DIFFERENCE (m): 0.588

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 48.651
LGRP Yrcs POSITION (m): 0.025
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Yrcs Position (m) GPS (.), Truth ( )

NRP Yrcs Tot Sys Diff (m)

NRP - Zrcs (m) GPS (.), Truth ( )

NRP - Zrcs Tot Sys Diff (m)
APPROACH #: SU428546  
START TIME: 331516.249  
STOP TIME: 331627.999

MINIMUM HDOP: 3.0  
MAXIMUM HDOP: 3.0  
AVERAGE HDOP: 3.0

MINIMUM VDOP: 9.9  
MAXIMUM VDOP: 10.1  
AVERAGE VDOP: 10.0

MINIMUM NUMBER OF SVs: 4  
MAXIMUM NUMBER OF SVs: 4  
AVERAGE NUMBER OF SVs: 4

**********************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY  *
**********************************************************************************

**********************************************************************************
* VALID APPROACH  *
**********************************************************************************

**********************************************************************************
* SUCCESSFUL APPROACH  *
**********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.589  
NRP Yrcs MEAN DIFFERENCE (m): -0.176  
NRP Zrcs MEAN DIFFERENCE (m): 0.071  
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.364  
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.211  
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.215  
NRP Xrcs RMS DIFFERENCE (m): 1.233  
NRP Yrcs RMS DIFFERENCE (m): 0.410  
NRP Zrcs RMS DIFFERENCE (m): 0.257

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 92.407  
LGRP Yrcs POSITION (m): 0.799

APPROACH #: SU428546  
START TIME: 331516.249  
STOP TIME: 331627.999

MINIMUM HDOP: 3.0  
MAXIMUM HDOP: 3.0  
AVERAGE HDOP: 3.0

MINIMUM VDOP: 9.9  
MAXIMUM VDOP: 10.1  
AVERAGE VDOP: 10.0

MINIMUM NUMBER OF SVs: 4  
MAXIMUM NUMBER OF SVs: 4  
AVERAGE NUMBER OF SVs: 4

**********************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY  *
**********************************************************************************

**********************************************************************************
* UNSUCCESSFUL APPROACH (MOS I) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN THE VERTICAL FILTER REQUIREMENTS  *
**********************************************************************************

**********************************************************************************
* VALID APPROACH  *
**********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.589  
NRP Yrcs MEAN DIFFERENCE (m): -0.176  
NRP Zrcs MEAN DIFFERENCE (m): 0.071  
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.364  
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.211  
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.215  
NRP Xrcs RMS DIFFERENCE (m): 1.233  
NRP Yrcs RMS DIFFERENCE (m): 0.410  
NRP Zrcs RMS DIFFERENCE (m): 0.257

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 92.407  
LGRP Yrcs POSITION (m): 0.799

261
APPROACH #: SU428548
START TIME: 331939.499
STOP TIME: 332048.499

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.7

MINIMUM VDOP: 8.9
MAXIMUM VDOP: 9.2
AVERAGE VDOP: 9.1

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
******************************************************************************

NRP Xrcs MEAN DIFFERENCE (m): 0.522
NRP Yrcs MEAN DIFFERENCE (m): -0.176
NRP Zrcs MEAN DIFFERENCE (m): 0.087

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.398
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.183
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.259

NRP Xrcs 2-RMS DIFFERENCE (m): 1.117
NRP Yrcs 2-RMS DIFFERENCE (m): 0.397
NRP Zrcs 2-RMS DIFFERENCE (m): 0.312

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
******************************************************************************

LGRP Xrcs POSITION (m): 138.640
LGRP Yrcs POSITION (m): 0.571

******************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
******************************************************************************

******************************************************************************
* UNSUCCESSFUL APPROACH (MS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
******************************************************************************

NRP Xrcs MEAN DIFFERENCE (m): 0.522
NRP Yrcs MEAN DIFFERENCE (m): -0.176
NRP Zrcs MEAN DIFFERENCE (m): 0.087

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.398
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.183
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.259

NRP Xrcs 2-RMS DIFFERENCE (m): 1.117
NRP Yrcs 2-RMS DIFFERENCE (m): 0.397
NRP Zrcs 2-RMS DIFFERENCE (m): 0.312

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
******************************************************************************

LGRP Xrcs POSITION (m): 138.640
LGRP Yrcs POSITION (m): 0.571
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Yrcs Position (m) GPS (-), Truth (-)

NRP Yrcs Tot Sys Diff (m)

NRP Zrcs Position (m) GPS (-), Truth (-)

NRP Zrcs Tot Sys Diff (m)
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428548

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428550
START TIME: 332349.499
STOP TIME: 332459.249

MINIMUM HDOP: 2.5
MAXIMUM HDOP: 2.5
AVERAGE HDOP: 2.5

MINIMUM VDOP: 7.8
MAXIMUM VDOP: 8.1
AVERAGE VDOP: 7.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************

******************************************************
* VALID APPROACH *
******************************************************

******************************************************
* SUCCESSFUL APPROACH *
******************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.704
NRP Yrcs MEAN DIFFERENCE (m): -0.194
NRP Zrcs MEAN DIFFERENCE (m): 0.107

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.305
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.365
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.250

NRP Xrcs 2-RMS DIFFERENCE (m): 1.440
NRP Yrcs 2-RMS DIFFERENCE (m): 0.533
NRP Zrcs 2-RMS DIFFERENCE (m): 0.328

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 99.671
LGRP Yrcs POSITION (m): -2.033

******************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
******************************************************

******************************************************
* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
******************************************************

******************************************************
* VALID APPROACH *
******************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.704
NRP Yrcs MEAN DIFFERENCE (m): -0.194
NRP Zrcs MEAN DIFFERENCE (m): 0.107

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.305
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.365
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.250

NRP Xrcs 2-RMS DIFFERENCE (m): 1.440
NRP Yrcs 2-RMS DIFFERENCE (m): 0.533
NRP Zrcs 2-RMS DIFFERENCE (m): 0.328

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 99.671
LGRP Yrcs POSITION (m): -2.033
PATH FOLLOWING ERROR

Lateral PFE Filter Output (m)

SU428550

CONTROL MOTION NOISE

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

NRP Xrcs Position (m)
**APPROACH #: SU428552**

**START TIME: 332767.249**

**STOP TIME: 332880.249**

**MINIMUM HDOP: 2.4**

**MAXIMUM HDOP: 2.4**

**AVERAGE HDOP: 2.4**

**MINIMUM VDOP: 6.6**

**MAXIMUM VDOP: 6.9**

**AVERAGE VDOP: 6.7**

**MINIMUM NUMBER OF SVs: 4**

**MAXIMUM NUMBER OF SVs: 4**

**AVERAGE NUMBER OF SVs: 4**

************************************************************************************

* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *

************************************************************************************

* VALID APPROACH *

************************************************************************************

* SUCCESSFUL APPROACH *

************************************************************************************

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

<table>
<thead>
<tr>
<th>NRPP Xrccs MEAN DIFFERENCE (m)</th>
<th>NRPP Yrccs MEAN DIFFERENCE (m)</th>
<th>NRPP Zrccs MEAN DIFFERENCE (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.606</td>
<td>-0.110</td>
<td>-0.041</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NRPP Xrccs 2-SIGMA DIFFERENCE (m)</th>
<th>NRPP Yrccs 2-SIGMA DIFFERENCE (m)</th>
<th>NRPP Zrccs 2-SIGMA DIFFERENCE (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.204</td>
<td>0.216</td>
<td>0.208</td>
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</table>

<table>
<thead>
<tr>
<th>NRPP Xrccs 2-RMS DIFFERENCE (m)</th>
<th>NRPP Yrccs 2-RMS DIFFERENCE (m)</th>
<th>NRPP Zrccs 2-RMS DIFFERENCE (m)</th>
</tr>
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<tbody>
<tr>
<td>1.229</td>
<td>0.309</td>
<td>0.224</td>
</tr>
</tbody>
</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>LGRP Xrccs POSITION (m)</th>
<th>LGRP Yrccs POSITION (m)</th>
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<tbody>
<tr>
<td>50.146</td>
<td>1.617</td>
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**APPROACH #: SU428552**

**START TIME: 332767.249**

**STOP TIME: 332880.249**

**MINIMUM HDOP: 2.4**

**MAXIMUM HDOP: 2.4**

**AVERAGE HDOP: 2.4**

**MINIMUM VDOP: 6.6**

**MAXIMUM VDOP: 6.9**

**AVERAGE VDOP: 6.7**

**MINIMUM NUMBER OF SVs: 4**

**MAXIMUM NUMBER OF SVs: 4**

**AVERAGE NUMBER OF SVs: 4**

************************************************************************************

* METHOD OF EVALUATION: SENSOR ACCURACY *

************************************************************************************

* UNSUCCESSFUL APPROACH (NO. 1) DUE TO LESS THAN *

* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *

* THE VERTICAL FILTER REQUIREMENTS *

************************************************************************************

* VALID APPROACH *

************************************************************************************

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

<table>
<thead>
<tr>
<th>NRPP Xrccs MEAN DIFFERENCE (m)</th>
<th>NRPP Yrccs MEAN DIFFERENCE (m)</th>
<th>NRPP Zrccs MEAN DIFFERENCE (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.606</td>
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<table>
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<tr>
<th>NRPP Xrccs 2-SIGMA DIFFERENCE (m)</th>
<th>NRPP Yrccs 2-SIGMA DIFFERENCE (m)</th>
<th>NRPP Zrccs 2-SIGMA DIFFERENCE (m)</th>
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</thead>
<tbody>
<tr>
<td>0.204</td>
<td>0.216</td>
<td>0.208</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NRPP Xrccs 2-RMS DIFFERENCE (m)</th>
<th>NRPP Yrccs 2-RMS DIFFERENCE (m)</th>
<th>NRPP Zrccs 2-RMS DIFFERENCE (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.229</td>
<td>0.309</td>
<td>0.224</td>
</tr>
</tbody>
</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>LGRP Xrccs POSITION (m)</th>
<th>LGRP Yrccs POSITION (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.146</td>
<td>1.617</td>
</tr>
</tbody>
</table>
PATH FOLLOWING ERROR

SU428552

CONTROL MOTION NOISE

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428552:

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428554
START TIME: 333178.499
STOP TIME: 333291.999

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 5.6
MAXIMUM VDOP: 5.8
AVERAGE VDOP: 5.7

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.590
NRP Yrcs MEAN DIFFERENCE (m): -0.074
NRP Zrcs MEAN DIFFERENCE (m): 0.005

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.219
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.176
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.236

NRP Xrcs 2-RMS DIFFERENCE (m): 1.200
NRP Yrcs 2-RMS DIFFERENCE (m): 0.230
NRP Zrcs 2-RMS DIFFERENCE (m): 0.236

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 185.309
LGRP Yrcs POSITION (m): -1.307
PATH FOLLOWING ERROR

SU428554

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

NRP Xrcs Position (m)
APPROACH #: SU428556
START TIME: 333576.999
STOP TIME: 333689.999

MINIMUM HDOP: 2.5
MAXIMUM HDOP: 2.5
AVERAGE HDOP: 2.5

MINIMUM VDOP: 4.8
MAXIMUM VDOP: 5.0
AVERAGE VDOP: 4.9

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.691
NRP Yrcs MEAN DIFFERENCE (m): -0.139
NRP Zrcs MEAN DIFFERENCE (m): -0.048

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.341
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.283
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.185

NRP Xrcs 2-RMS DIFFERENCE (m): 1.424
NRP Yrcs 2-RMS DIFFERENCE (m): 0.396
NRP Zrcs 2-RMS DIFFERENCE (m): 0.209

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 229.468
LGRP Yrcs POSITION (m): -1.694

******************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
******************************************************************************

******************************************************************************
* UNSUCCESSFUL APPROACH (MD 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.691
NRP Yrcs MEAN DIFFERENCE (m): -0.139
NRP Zrcs MEAN DIFFERENCE (m): -0.048

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.341
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.283
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.185

NRP Xrcs 2-RMS DIFFERENCE (m): 1.424
NRP Yrcs 2-RMS DIFFERENCE (m): 0.396
NRP Zrcs 2-RMS DIFFERENCE (m): 0.209

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 229.468
LGRP Yrcs POSITION (m): -1.694
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

SU428556

NRP Yrcs Position (m)

NRP Xrcs Position (m)

NRP Yrcs Tot Sys Diff (m)

NRP Xrcs Tot Sys Diff (m)
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Vertical PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical CMN Filter Output (m)

SU428556
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

SU428556
APPROACH #: SU428558
START TIME: 334010.499
STOP TIME: 334123.499
MINIMUM HDOP: 1.9
MAXIMUM HDOP: 2.0
AVERAGE HDOP: 1.9
MINIMUM VDOP: 3.6
MAXIMUM VDOP: 3.7
AVERAGE VDOP: 3.7
MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************

* VALID APPROACH *

******************************************************
* SUCCESSFUL APPROACH *

******************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.753
NRP Yrcs MEAN DIFFERENCE (m): -0.101
NRP Zrcs MEAN DIFFERENCE (m): -0.014
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.349
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.231
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.194
NRP Xrcs 2-RMS DIFFERENCE (m): 1.546
NRP Yrcs 2-RMS DIFFERENCE (m): 0.307
NRP Zrcs 2-RMS DIFFERENCE (m): 0.196

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 240.821
LGRP Yrcs POSITION (m): -0.994
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428558

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428560
START TIME: 334432.749
STOP TIME: 334545.249

MINIMUM HDOP: 2.1
MAXIMUM HDOP: 2.1
AVERAGE HDOP: 2.1

MINIMUM VDOP: 3.4
MAXIMUM VDOP: 3.5
AVERAGE VDOP: 3.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY              *
*************************************************************

* VALID APPROACH                                            *
*************************************************************

SUCCESSFUL APPROACH
*************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
--------------------------------------------------
NRP Xrcs MEAN DIFFERENCE (m) : 0.582
NRP Yrcs MEAN DIFFERENCE (m) : -0.146
NRP Zrcs MEAN DIFFERENCE (m) : -0.051

NRP Xrcs 2-SIGMA DIFFERENCE (m) : 0.326
NRP Yrcs 2-SIGMA DIFFERENCE (m) : 0.327
NRP Zrcs 2-SIGMA DIFFERENCE (m) : 0.185

NRP Xrcs 2-RMS DIFFERENCE (m) : 1.208
NRP Yrcs 2-RMS DIFFERENCE (m) : 0.438
NRP Zrcs 2-RMS DIFFERENCE (m) : 0.212

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
-----------------------------------------------
LGRP Xrcs POSITION (m) : 298.256
LGRP Yrcs POSITION (m) : -0.887

TOTAL SYSTEM ACCURACY
---------------------
*         *

SUCCESSFUL APPROACH
*************************************************************

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
-----------------------------------------------
LGRP Xrcs POSITION (m) : 298.256
LGRP Yrcs POSITION (m) : -0.887
APPROACH #: SU428562
START TIME: 334865.749
STOP TIME: 334987.249

MINIMUM HDOP: 5.2
MAXIMUM HDOP: 6.0
AVERAGE HDOP: 5.6

MINIMUM VDOP: 12.3
MAXIMUM VDOP: 14.7
AVERAGE VDOP: 13.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

%%%%%%%%%%%%%%%%%%%%%%%%
METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY
%%%%%%%%%%%%%%%%%%%%%%%%

* UNSUCCESSFUL APPROACH (MQS 3) DUE TO VIOLATION OF THE VERTICAL TUNNEL BOUNDARY *

%%%%%%%%%%%%%%%%%%%%%%%%
VALID APPROACH
%%%%%%%%%%%%%%%%%%%%%%%%

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.603
NRP Xrcs MEAN DIFFERENCE (m): -0.107
NRP Zrcs MEAN DIFFERENCE (m): 0.001

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.297
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.275
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.215

NRP Xrcs 2-RMS DIFFERENCE (m): 1.243
NRP Yrcs 2-RMS DIFFERENCE (m): 0.348
NRP Zrcs 2-RMS DIFFERENCE (m): 0.215

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 74.498
LGRP Yrcs POSITION (m): 1.592

APPROACH #: SU428562
START TIME: 334865.749
STOP TIME: 334987.249

MINIMUM HDOP: 5.2
MAXIMUM HDOP: 6.0
AVERAGE HDOP: 5.6

MINIMUM VDOP: 12.3
MAXIMUM VDOP: 14.7
AVERAGE VDOP: 13.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

%%%%%%%%%%%%%%%%%%%%%%%%
METHOD OF EVALUATION: SENSOR ACCURACY
%%%%%%%%%%%%%%%%%%%%%%%%

* UNSUCCESSFUL APPROACH (MQS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN THE VERTICAL FILTER REQUIREMENTS *

%%%%%%%%%%%%%%%%%%%%%%%%
VALID APPROACH
%%%%%%%%%%%%%%%%%%%%%%%%

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.603
NRP Yrcs MEAN DIFFERENCE (m): -0.107
NRP Zrcs MEAN DIFFERENCE (m): 0.001

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.297
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.275
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.215

NRP Xrcs 2-RMS DIFFERENCE (m): 1.243
NRP Yrcs 2-RMS DIFFERENCE (m): 0.348
NRP Zrcs 2-RMS DIFFERENCE (m): 0.215

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 74.498
LGRP Yrcs POSITION (m): 1.592

293
PATH FOLLOWING ERROR

SU428562

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Vertical PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical CMN Filter Output (m)
APPROACH #: SU428564
START TIME: 335799.249
STOP TIME: 335912.999

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.6
MAXIMUM VDOP: 5.9
AVERAGE VDOP: 5.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

***********************************************************
* VALID APPROACH                                         *
***********************************************************

***********************************************************
* SUCCESSFUL APPROACH                                    *
***********************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.681
NRP Yrcs MEAN DIFFERENCE (m): -0.114
NRP Zrcs MEAN DIFFERENCE (m): 0.103

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.228
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.255
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.263

NRP Xrcs 2-RMS DIFFERENCE (m): 1.382
NRP Yrcs 2-RMS DIFFERENCE (m): 0.342
NRP Zrcs 2-RMS DIFFERENCE (m): 0.335

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 96.249
LGRP Yrcs POSITION (m): -0.341

APPROACH #: SU428564
START TIME: 335799.249
STOP TIME: 335912.999

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.6
MAXIMUM VDOP: 5.9
AVERAGE VDOP: 5.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*******************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY                                     *
*******************************************************************************

*******************************************************************************
* UNSUCCESSFUL APPROACH (LOS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN THE VERTICAL FILTER REQUIREMENTS *
*******************************************************************************

*******************************************************************************
* VALID APPROACH                                                             *
*******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.681
NRP Yrcs MEAN DIFFERENCE (m): -0.114
NRP Zrcs MEAN DIFFERENCE (m): 0.103

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.228
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.255
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.263

NRP Xrcs 2-RMS DIFFERENCE (m): 1.382
NRP Yrcs 2-RMS DIFFERENCE (m): 0.342
NRP Zrcs 2-RMS DIFFERENCE (m): 0.335

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 96.249
LGRP Yrcs POSITION (m): -0.341
**APPROACH #: SU428610**  
**START TIME:** 408867.249  
**STOP TIME:** 408971.249

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<thead>
<tr>
<th>Minimum HDOP</th>
<th>Maximum HDOP</th>
<th>Average HDOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td>2.3</td>
<td>2.3</td>
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</table>

<table>
<thead>
<tr>
<th>Minimum VDOP</th>
<th>Maximum VDOP</th>
<th>Average VDOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9</td>
<td>4.0</td>
<td>3.9</td>
</tr>
</tbody>
</table>

**Minimum Number of SVs:** 4  
**Average Number of SVs:** 4

***TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT***

<table>
<thead>
<tr>
<th>NRP Xrcs Mean Difference (m)</th>
<th>NRP Yrcs Mean Difference (m)</th>
<th>NRP Zrcs Mean Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.257</td>
<td>-0.091</td>
<td>0.041</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NRP Xrcs 2-Sigma Difference (m)</th>
<th>NRP Yrcs 2-Sigma Difference (m)</th>
<th>NRP Zrcs 2-Sigma Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.103</td>
<td>0.123</td>
<td>0.234</td>
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</table>

<table>
<thead>
<tr>
<th>NRP Xrcs 2-RMS Difference (m)</th>
<th>NRP Yrcs 2-RMS Difference (m)</th>
<th>NRP Zrcs 2-RMS Difference (m)</th>
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<tbody>
<tr>
<td>0.525</td>
<td>0.220</td>
<td>0.248</td>
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**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>LGRP Xrcs Position (m)</th>
<th>LGRP Yrcs Position (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>204.498</td>
<td>-0.537</td>
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</tbody>
</table>
PATH FOLLOWING ERROR

Lateral PFE Filter Output (m)

SU428610

CONTROL MOTION NOISE

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

NRP Xrcs Position (m)

Vertical CMN Filter Output (m)

NRP Xrcs Position (m)
APPROACH #: SU428614
START TIME: 409663.749
STOP TIME: 409764.749

MINIMUM HDOP: 2.2
MAXIMUM HDOP: 2.2
AVERAGE HDOP: 2.2

MINIMUM VDOP: 3.5
MAXIMUM VDOP: 3.5
AVERAGE VDOP: 3.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************

********************
* VALID APPROACH *
********************

******************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
******************************

********************
* UNSUCCESSFUL APPROACH (POS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
********************

********************
* VALID APPROACH *
********************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.367
NRP Yrcs MEAN DIFFERENCE (m): -0.108
NRP Zrcs MEAN DIFFERENCE (m): 0.068

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.117
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.217
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.210

NRP Xrcs 2-RMS DIFFERENCE (m): 0.743
NRP Yrcs 2-RMS DIFFERENCE (m): 0.306
NRP Zrcs 2-RMS DIFFERENCE (m): 0.251

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 169.845
LGRP Yrcs POSITION (m): 2.610
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428614

NRP X RCS Position (m)
APPROACH #: SU428616
START TIME: 410056.999
STOP TIME: 410163.499

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 4.3
MAXIMUM VDOP: 4.4
AVERAGE VDOP: 4.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*******************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*******************************

********************************
* VALID APPROACH *
********************************

*******************************
* SUCCESSFUL APPROACH *
*******************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.309
NRP Yrcs MEAN DIFFERENCE (m): -0.154
NRP Zrcs MEAN DIFFERENCE (m): 0.025

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.152
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.120
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.199

NRP Xrcs 2-RMS DIFFERENCE (m): 0.637
NRP Yrcs 2-RMS DIFFERENCE (m): 0.331
NRP Zrcs 2-RMS DIFFERENCE (m): 0.206

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 257.102
LGRP Yrcs POSITION (m): 0.894
PATH FOLLOWING ERROR

Lateral PFE Filter Output (m)

-20 -10 0 10 20
-6000 -4000 -2000 0

SU428616

Lateral CMN Filter Output (m)

10 5 0 -5 -10
-6000 -4000 -2000 0

CONTROL MOTION NOISE

Vertical PFE Filter Output (m)

-20 -10 0 10 20
-6000 -4000 -2000 0

Vertical CMN Filter Output (m)

10 5 0 -5 -10
-6000 -4000 -2000 0

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xcs Diff (m)

NRP Ycs Diff (m)

NRP Zcs Diff (m)

NRP Xcs Position (m)
APPROACH #: SU428618
START TIME: 410458.499
STOP TIME: 410566.749

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 4.5
MAXIMUM VDOP: 4.6
AVERAGE VDOP: 4.6

AVERAGE NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
MINIMUM NUMBER OF SVs: 4

METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY

VALID APPROACH
SUCCESSFUL APPROACH

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN difference (m): 0.263
NRP Yrcs MEAN difference (m): -0.033
NRP Zrcs MEAN difference (m): 0.054

NRP Xrcs 2-SIGMA difference (m): 0.126
NRP Yrcs 2-SIGMA difference (m): 0.110
NRP Zrcs 2-SIGMA difference (m): 0.225

NRP Xrcs 2-RMS difference (m): 0.540
NRP Yrcs 2-RMS difference (m): 0.128
NRP Zrcs 2-RMS difference (m): 0.250

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 153.020
LGRP Yrcs POSITION (m): 3.021

APPROACH #: SU428618
START TIME: 410458.499
STOP TIME: 410566.749

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 4.5
MAXIMUM VDOP: 4.6
AVERAGE VDOP: 4.6

AVERAGE NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
MINIMUM NUMBER OF SVs: 4

METHOD OF EVALUATION: SENSOR ACCURACY

VALID APPROACH
SUCCESSFUL APPROACH

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN difference (m): 0.263
NRP Yrcs MEAN difference (m): -0.033
NRP Zrcs MEAN difference (m): 0.054

NRP Xrcs 2-SIGMA difference (m): 0.126
NRP Yrcs 2-SIGMA difference (m): 0.110
NRP Zrcs 2-SIGMA difference (m): 0.225

NRP Xrcs 2-RMS difference (m): 0.540
NRP Yrcs 2-RMS difference (m): 0.128
NRP Zrcs 2-RMS difference (m): 0.250

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 153.020
LGRP Yrcs POSITION (m): 3.021
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs (m) GPS (.), Truth (-)

NRP Xrcs Position (m)

NRP Yrcs Tot Sys Diff (m)

NRP Xrcs Position (m)

NRP -Zrcs (m) GPS (.), Truth (-)

NRP Xrcs Position (m)

NRP -Zrcs Tot Sys Diff (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

![Graphs showing NRP Longitudinal, Lateral, and Vertical Position Differences](image_url)

**SU428618**
APPROACH #: SU428620
START TIME: 411299.999
STOP TIME: 411404.749

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.7
AVERAGE HDOP: 2.7
MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.4
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

AV_/_E HDOP: 2.7
AVI_hAf_E IkUMB}_ OF SVs: 4
MAXIMIIM _ OF SVs: 4
AVerAGE VDOP: 5.3

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPXrcs MEAN DIFFERENCE (m): 0.173
NRPYrcs MEAN DIFFERENCE (m): -0.094
NRPZrcs MEAN DIFFERENCE (m): 0.000
NRPXrcs 2-SIGMA DIFFERENCE (m): 0.200
NRPYrcs 2-SIGMA DIFFERENCE (m): 0.158
NRPZrcs 2-SIGMA DIFFERENCE (m): 0.240
NRPXrcs 2-RMS DIFFERENCE (m): 0.399
NRPYrcs 2-RMS DIFFERENCE (m): 0.246
NRPZrcs 2-RMS DIFFERENCE (m): 0.240

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRPXrcs POSITION (m): 244.557
LGRPYrcs POSITION (m): 1.156

NRPXrcs MEAN DIFFERENCE (m): 0.173
NRPYrcs MEAN DIFFERENCE (m): -0.094
NRPZrcs MEAN DIFFERENCE (m): 0.000
NRPXrcs 2-SIGMA DIFFERENCE (m): 0.200
NRPYrcs 2-SIGMA DIFFERENCE (m): 0.158
NRPZrcs 2-SIGMA DIFFERENCE (m): 0.240
NRPXrcs 2-RMS DIFFERENCE (m): 0.399
NRPYrcs 2-RMS DIFFERENCE (m): 0.246
NRPZrcs 2-RMS DIFFERENCE (m): 0.240

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRPXrcs POSITION (m): 244.557
LGRPYrcs POSITION (m): 1.156
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)
APPROACH #: SU428622
START TIME: 411712.499
STOP TIME: 411818.999

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.0

MINIMUM VDOP: 5.9
MAXIMUM VDOP: 6.1
AVERAGE VDOP: 6.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*********************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*********************************************************

*********************************************************
* VALID APPROACH *
*********************************************************

*********************************************************
* SUCCESSFUL APPROACH *
*********************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xr MultMEAN DIFFERENCE (m): 0.280
NRP Yr MultMEAN DIFFERENCE (m): -0.159
NRP Zr MultMEAN DIFFERENCE (m): 0.053

NRP Xr Mult2-SIGMA DIFFERENCE (m): 0.144
NRP Yr Mult2-SIGMA DIFFERENCE (m): 0.172
NRP Zr Mult2-SIGMA DIFFERENCE (m): 0.197

NRP Xr Mult2-RMS DIFFERENCE (m): 0.579
NRP Yr Mult2-RMS DIFFERENCE (m): 0.361
NRP Zr Mult2-RMS DIFFERENCE (m): 0.224

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xr Mult POSITION (m): 282.318
LGRP Yr Mult POSITION (m): 1.215
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428624
START TIME: 412137.499
STOP TIME: 412243.749

MINIMUM HDOP: 3.1
MAXIMUM HDOP: 3.2
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*********************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY                      *
*********************************************************************

* VALID APPROACH *

*********************************************************************
* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.412
NRP Yrcs MEAN DIFFERENCE (m): -0.102
NRP Zrcs MEAN DIFFERENCE (m): 0.078

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.245
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.116
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.248

NRP Xrcs 2-RMS DIFFERENCE (m): 0.659
NRP Yrcs 2-RMS DIFFERENCE (m): 0.235
NRP Zrcs 2-RMS DIFFERENCE (m): 0.293

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 134.851
LGRP Yrcs POSITION (m): 1.619
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428624:

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428626
START TIME: 412521.749
STOP TIME: 412627.749

MINIMUM HDOP: 2.9
MAXIMUM HDOP: 3.0
AVERAGE HDOP: 2.9

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.401
NRP Yrcs MEAN DIFFERENCE (m): -0.085
NRP Zrcs MEAN DIFFERENCE (m): 0.086

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.248
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.104
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.231

NRP Xrcs 2-RMS DIFFERENCE (m): 0.840
NRP Yrcs 2-RMS DIFFERENCE (m): 0.199
NRP Zrcs 2-RMS DIFFERENCE (m): 0.287

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 312.822
LGRP Yrcs POSITION (m): 3.661
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428626:

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428628  
START TIME: 412926.749  
STOP TIME: 413034.499

MINIMUM HDOP: 2.8  
MAXIMUM HDOP: 2.8  
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.3  
MAXIMUM VDOP: 5.3  
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4  
MAXIMUM NUMBER OF SVs: 4  
AVERAGE NUMBER OF SVs: 4

*************************************************  
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY  *  
*************************************************

*************************************************  
* VALID APPROACH  
*************************************************

*************************************************  
* SUCCESSFUL APPROACH  
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.431  
NRP Yrcs MEAN DIFFERENCE (m): -0.169  
NRP Zrcs MEAN DIFFERENCE (m): 0.118

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.162  
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.229  
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.206

NRP Xrcs 2-RMS DIFFERENCE (m): 0.877  
NRP Yrcs 2-RMS DIFFERENCE (m): 0.409  
NRP Zrcs 2-RMS DIFFERENCE (m): 0.314

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 125.848  
LGRP Yrcs POSITION (m): 2.862

APPROACH #: SU428628  
START TIME: 412926.749  
STOP TIME: 413034.499

MINIMUM HDOP: 2.8  
MAXIMUM HDOP: 2.8  
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.3  
MAXIMUM VDOP: 5.3  
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4  
MAXIMUM NUMBER OF SVs: 4  
AVERAGE NUMBER OF SVs: 4

*************************************************  
* METHOD OF EVALUATION: SENSOR ACCURACY  
*************************************************

*************************************************  
* VALID APPROACH  
*************************************************

*************************************************  
* SUCCESSFUL APPROACH  
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.431  
NRP Yrcs MEAN DIFFERENCE (m): -0.169  
NRP Zrcs MEAN DIFFERENCE (m): 0.118

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.162  
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.229  
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.206

NRP Xrcs 2-RMS DIFFERENCE (m): 0.877  
NRP Yrcs 2-RMS DIFFERENCE (m): 0.409  
NRP Zrcs 2-RMS DIFFERENCE (m): 0.314

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 125.848  
LGRP Yrcs POSITION (m): 2.862

333
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

SU428628

NRP Xrcs Position (m)
**APPROACH #: SU428630**
**START TIME: 413334.499**
**STOP TIME: 413444.249**

- Minimum HDOP: 2.7
- Maximum HDOP: 2.7
- Average HDOP: 2.7

- Minimum VDOP: 5.3
- Maximum VDOP: 5.3
- Average VDOP: 5.3

- Minimum Number of SVs: 4
- Maximum Number of SVs: 4
- Average Number of SVs: 4

*****************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*****************************************************

*****************************************************
* VALID APPROACH *
*****************************************************

*****************************************************
* SUCCESSFUL APPROACH *
*****************************************************

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Mean Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xrcs</td>
<td>0.325</td>
</tr>
<tr>
<td>Yrcs</td>
<td>-0.090</td>
</tr>
<tr>
<td>Zrcs</td>
<td>-0.070</td>
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</table>

<table>
<thead>
<tr>
<th>Direction</th>
<th>2-Sigma Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xrcs</td>
<td>0.179</td>
</tr>
<tr>
<td>Yrcs</td>
<td>0.156</td>
</tr>
<tr>
<td>Zrcs</td>
<td>0.222</td>
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</table>

<table>
<thead>
<tr>
<th>Direction</th>
<th>2-RMS Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xrcs</td>
<td>0.675</td>
</tr>
<tr>
<td>Yrcs</td>
<td>0.238</td>
</tr>
<tr>
<td>Zrcs</td>
<td>0.262</td>
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</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Position (m)</th>
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<tbody>
<tr>
<td>Xrcs</td>
<td>290.016</td>
</tr>
<tr>
<td>Yrcs</td>
<td>-3.644</td>
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</tbody>
</table>

**APPROACH #: SU428630**
**START TIME: 413334.499**
**STOP TIME: 413444.249**

- Minimum HDOP: 2.7
- Maximum HDOP: 2.7
- Average HDOP: 2.7

- Minimum VDOP: 5.3
- Maximum VDOP: 5.3
- Average VDOP: 5.3

- Minimum Number of SVs: 4
- Maximum Number of SVs: 4
- Average Number of SVs: 4

*****************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*****************************************************

*****************************************************
* VALID APPROACH *
*****************************************************

*****************************************************
* SUCCESSFUL APPROACH *
*****************************************************

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

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**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

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<td>Yrcs</td>
<td>-3.644</td>
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</table>
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428632
START TIME: 413727.749
STOP TIME: 413835.499

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.7
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

**********************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
**********************

************
* VALID APPROACH *
************

************
* SUCCESSFUL APPROACH *
************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 214.967
LGRP Yrcs POSITION (m): 0.654

LGRP Xrcs POSITION (m): 214.967
LGRP Yrcs POSITION (m): 0.654

FEATURES MEAN (m): 0.406
FEATURES MEAN (m): 0.406
FEATURES MEAN (m): -0.151
FEATURES MEAN (m): -0.151
FEATURES MEAN (m): 0.000
FEATURES MEAN (m): 0.000

FEATURES 2-SIGMA DIFFERENCE (m): 0.233
FEATURES 2-SIGMA DIFFERENCE (m): 0.233
FEATURES 2-SIGMA DIFFERENCE (m): 0.199
FEATURES 2-SIGMA DIFFERENCE (m): 0.199
FEATURES 2-SIGMA DIFFERENCE (m): 0.243
FEATURES 2-SIGMA DIFFERENCE (m): 0.243

FEATURES 2-RMS DIFFERENCE (m): 0.844
FEATURES 2-RMS DIFFERENCE (m): 0.844
FEATURES 2-RMS DIFFERENCE (m): 0.362
FEATURES 2-RMS DIFFERENCE (m): 0.362
FEATURES 2-RMS DIFFERENCE (m): 0.243
FEATURES 2-RMS DIFFERENCE (m): 0.243
APPROACH #: SU428634
START TIME: 414109.249
STOP TIME: 414216.749

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.4
MAXIMUM VDOP: 5.4
AVERAGE VDOP: 5.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

* VALID APPROACH

*************************************************
* SUCCESSFUL APPROACH

*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.465
NRP Yrcs MEAN DIFFERENCE (m): -0.146
NRP Zrcs MEAN DIFFERENCE (m): 0.019

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.181
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.235
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.225

NRP Xrcs 2-RMS DIFFERENCE (m): 0.947
NRP Yrcs 2-RMS DIFFERENCE (m): 0.375
NRP Zrcs 2-RMS DIFFERENCE (m): 0.228

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 86.153
LGRP Yrcs POSITION (m): 2.935

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 86.153
LGRP Yrcs POSITION (m): 2.935
APPROACH #: SU428636
START TIME: 414492.749
STOP TIME: 414601.999

MINIMUM HDOP: 2.9
MAXIMUM HDOP: 3.0
AVERAGE HDOP: 2.9

MINIMUM VDOP: 5.5
MAXIMUM VDOP: 5.6
AVERAGE VDOP: 5.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
***************************************************************

* VALID APPROACH *

***************************************************************
* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.410
NRP Yrcs MEAN DIFFERENCE (m): -0.037
NRP Zrcs MEAN DIFFERENCE (m): 0.067

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.237
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.190
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.221

NRP Xrcs 2-RMS DIFFERENCE (m): 0.854
NRP Yrcs 2-RMS DIFFERENCE (m): 0.204
NRP Zrcs 2-RMS DIFFERENCE (m): 0.259

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 141.721
LGRP Yrcs POSITION (m): 3.232

APPROACH #: SU428636
START TIME: 414492.749
STOP TIME: 414601.999

MINIMUM HDOP: 2.9
MAXIMUM HDOP: 3.0
AVERAGE HDOP: 2.9

MINIMUM VDOP: 5.5
MAXIMUM VDOP: 5.6
AVERAGE VDOP: 5.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
***************************************************************

* VALID APPROACH *

***************************************************************
* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.410
NRP Yrcs MEAN DIFFERENCE (m): -0.037
NRP Zrcs MEAN DIFFERENCE (m): 0.067

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.237
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.190
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.221

NRP Xrcs 2-RMS DIFFERENCE (m): 0.854
NRP Yrcs 2-RMS DIFFERENCE (m): 0.204
NRP Zrcs 2-RMS DIFFERENCE (m): 0.259

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 141.721
LGRP Yrcs POSITION (m): 3.232
APPROACH #: SU428638
START TIME: 414898.749
STOP TIME: 415011.999

MINIMUM HDOP: 3.1
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.8
MAXIMUM VDOP: 5.8
AVERAGE VDOP: 5.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPX MEAN DIFFERENCE (m): 0.469
NRPY MEAN DIFFERENCE (m): -0.105
NRPZ MEAN DIFFERENCE (m): 0.171

NRPX 2-SIGMA DIFFERENCE (m): 0.240
NRPY 2-SIGMA DIFFERENCE (m): 0.270
NRPZ 2-SIGMA DIFFERENCE (m): 0.231

NRPX 2-RMS DIFFERENCE (m): 0.968
NRPY 2-RMS DIFFERENCE (m): 0.342
NRPZ 2-RMS DIFFERENCE (m): 0.413

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRPX POSITION (m): 140.772
LGRPY POSITION (m): 1.396

APPROACH #: SU428638
START TIME: 414898.749
STOP TIME: 415011.999

MINIMUM HDOP: 3.1
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.1

MINIMUM VDOP: 5.8
MAXIMUM VDOP: 5.8
AVERAGE VDOP: 5.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
******************************************************************************

******************************************************************************
* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPX MEAN DIFFERENCE (m): 0.469
NRPY MEAN DIFFERENCE (m): -0.105
NRPZ MEAN DIFFERENCE (m): 0.171

NRPX 2-SIGMA DIFFERENCE (m): 0.240
NRPY 2-SIGMA DIFFERENCE (m): 0.270
NRPZ 2-SIGMA DIFFERENCE (m): 0.231

NRPX 2-RMS DIFFERENCE (m): 0.968
NRPY 2-RMS DIFFERENCE (m): 0.342
NRPZ 2-RMS DIFFERENCE (m): 0.413

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRPX POSITION (m): 140.772
LGRPY POSITION (m): 1.396
PATH FOLLOWING ERROR

SU428638

CONTROL MOTION NOISE
**APPROACH #: SU428640**

**START TIME:** 415894.999

**STOP TIME:** 416013.749

**MINIMUM HDOP:** 3.7

**MAXIMUM HDOP:** 3.8

**AVERAGE HDOP:** 3.7

**MINIMUM VDOP:** 7.2

**MAXIMUM VDOP:** 7.5

**AVERAGE VDOP:** 7.4

**MINIMUM NUMBER OF SVs:** 4

**MAXIMUM NUMBER OF SVs:** 4

**AVERAGE NUMBER OF SVs:** 4

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

<table>
<thead>
<tr>
<th>NRP Xrcs MEAN DIFFERENCE (m)</th>
<th>0.421</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRP Yrcs MEAN DIFFERENCE (m)</td>
<td>-0.142</td>
</tr>
<tr>
<td>NRP Zrcs MEAN DIFFERENCE (m)</td>
<td>0.045</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NRP Xrcs 2-SIGMA DIFFERENCE (m)</th>
<th>0.210</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRP Yrcs 2-SIGMA DIFFERENCE (m)</td>
<td>0.220</td>
</tr>
<tr>
<td>NRP Zrcs 2-SIGMA DIFFERENCE (m)</td>
<td>0.210</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NRP Xrcs 2-RMS DIFFERENCE (m)</th>
<th>0.867</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRP Yrcs 2-RMS DIFFERENCE (m)</td>
<td>0.359</td>
</tr>
<tr>
<td>NRP Zrcs 2-RMS DIFFERENCE (m)</td>
<td>0.228</td>
</tr>
</tbody>
</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>LGRP Xrcs POSITION (m)</th>
<th>212.619</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGRP Yrcs POSITION (m)</td>
<td>-3.203</td>
</tr>
</tbody>
</table>
PATH FOLLOWING ERROR

SU428640

CONTROL MOTION NOISE
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428642
START TIME: 416327.499
STOP TIME: 416447.249

MINIMUM HDOP: 3.9
MAXIMUM HDOP: 4.0
AVERAGE HDOP: 3.9

MINIMUM VDOP: 8.4
MAXIMUM VDOP: 8.7
AVERAGE VDOP: 8.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***********************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
***********************************************************************

***********************************************************************
* VALID APPROACH *
***********************************************************************

***********************************************************************
* SUCCESSFUL APPROACH *
***********************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPXrcs MEAN DIFFERENCE (m): 0.419
NRPYrcs MEAN DIFFERENCE (m): -0.148
NRP Zrcs MEAN DIFFERENCE (m): 0.035

NRPXrcs 2-SIGMA DIFFERENCE (m): 0.233
NRPYrcs 2-SIGMA DIFFERENCE (m): 0.376
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.281

NRPXrcs 2-RMS DIFFERENCE (m): 0.870
NRPYrcs 2-RMS DIFFERENCE (m): 0.478
NRP Zrcs 2-RMS DIFFERENCE (m): 0.290

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 233.047
LGRP Yrcs POSITION (m): 1.531
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

SU428642
APPROACH #: SU428644
START TIME: 416731.249
STOP TIME: 416847.749

MINIMUM HDOP: 4.1
MAXIMUM HDOP: 4.1
AVERAGE HDOP: 4.1

MINIMUM VDOP: 9.5
MAXIMUM VDOP: 9.8
AVERAGE VDOP: 9.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.392
NRP Yrcs MEAN DIFFERENCE (m): -0.082
NRP Zrcs MEAN DIFFERENCE (m): -0.061

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.240
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.257
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.275

NRP Xrcs 2-RMS DIFFERENCE (m): 0.819
NRP Yrcs 2-RMS DIFFERENCE (m): 0.304
NRP Zrcs 2-RMS DIFFERENCE (m): 0.301

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 165.709
LGRP Yrcs POSITION (m): 4.090
PATH FOLLOWING ERROR

SU428644

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)
<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum HDOP</td>
<td>3.2</td>
</tr>
<tr>
<td>Maximum HDOP</td>
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<tr>
<td>Average HDOP</td>
<td>3.2</td>
</tr>
<tr>
<td>Minimum VDOP</td>
<td>10.3</td>
</tr>
<tr>
<td>Maximum VDOP</td>
<td>10.4</td>
</tr>
<tr>
<td>Average VDOP</td>
<td>10.3</td>
</tr>
<tr>
<td>Minimum number of SVs</td>
<td>4</td>
</tr>
<tr>
<td>Maximum number of SVs</td>
<td>4</td>
</tr>
<tr>
<td>Average number of SVs</td>
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</tbody>
</table>

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

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<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRP Xrcs Mean Difference</td>
<td>0.534</td>
</tr>
<tr>
<td>NRP Yrcs Mean Difference</td>
<td>-0.190</td>
</tr>
<tr>
<td>NRP Zrcs Mean Difference</td>
<td>0.001</td>
</tr>
<tr>
<td>NRP Xrcs 2-Sigma Difference</td>
<td>0.265</td>
</tr>
<tr>
<td>NRP Yrcs 2-Sigma Difference</td>
<td>0.405</td>
</tr>
<tr>
<td>NRP Zrcs 2-Sigma Difference</td>
<td>0.218</td>
</tr>
<tr>
<td>NRP Xrcs 2-RMS Difference</td>
<td>1.100</td>
</tr>
<tr>
<td>NRP Yrcs 2-RMS Difference</td>
<td>0.556</td>
</tr>
<tr>
<td>NRP Zrcs 2-RMS Difference</td>
<td>0.218</td>
</tr>
</tbody>
</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

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<tr>
<th>Metric</th>
<th>Value</th>
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<tbody>
<tr>
<td>LGRP Xrcs Position</td>
<td>392.889</td>
</tr>
<tr>
<td>LGRP Yrcs Position</td>
<td>2.417</td>
</tr>
</tbody>
</table>

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

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**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

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<tr>
<td>LGRP Yrcs Position</td>
<td>2.417</td>
</tr>
</tbody>
</table>
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Xrcs Position (m)

NRP Yrcs Tot Sys Diff (m)

NRP Zrcs Position (m)

NRP Zrcs Tot Sys Diff (m)
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

SU428646

NRP Xrcs Position (m)

NRP Xrcs Position (m)
APPROACH #: SU428648
START TIME: 417555.499
STOP TIME: 417670.499

MINIMUM HDOP: 3.0
MAXIMUM HDOP: 3.1
AVERAGE HDOP: 3.0

MINIMUM VDOP: 10.1
MAXIMUM VDOP: 10.3
AVERAGE VDOP: 10.2

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
*  METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY                           *
******************************************************************************

******************************************************************************
*  VALID APPROACH                                                           *
******************************************************************************

******************************************************************************
*  METHOD OF EVALUATION: SENSOR ACCURACY                                   *
******************************************************************************

******************************************************************************
*  UNSUCCESSFUL APPROACH (NDS 1) DUE TO LESS THAN*                        *
*  95 PERCENT OF ALL THE DATA POINTS WITHIN                               *
*  THE VERTICAL FILTER REQUIREMENTS                                    *
******************************************************************************

******************************************************************************
*  VALID APPROACH                                                          *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m) : 0.504
NRP Yrcs MEAN DIFFERENCE (m) : -0.126
NRP Zrcs MEAN DIFFERENCE (m) : 0.065
NRP Xrcs 2-SIGMA DIFFERENCE (m) : 0.299
NRP Yrcs 2-SIGMA DIFFERENCE (m) : 0.316
NRP Zrcs 2-SIGMA DIFFERENCE (m) : 0.268
NRP Xrcs 2-RMS DIFFERENCE (m) : 1.050
NRP Yrcs 2-RMS DIFFERENCE (m) : 0.404
NRP Zrcs 2-RMS DIFFERENCE (m) : 0.298

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m) : 161.042
LGRP Yrcs POSITION (m) : 3.234
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs (m) (GPS (.), Truth (-))

NRP -Zrcs (m) (GPS (.), Truth (-))

NRP Yrcs Tot Sys Diff (m)

NRP -Zrcs Tot Sys Diff (m)
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

SU428648
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

SU428648

NRP Xrcs Diff (m)

NRP Yrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Position (m)

NRP Zrcs Diff (m)
APPROACH #: SU428650
START TIME: 417993.499
STOP TIME: 418113.999

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 9.2
MAXIMUM VDOP: 9.5
AVERAGE VDOP: 9.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***********************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
***********************************************************************

***********************************************************************
* VALID APPROACH *
***********************************************************************

***********************************************************************
* SUCCESSFUL APPROACH *
***********************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xr cs MEAN DIFFERENCE (m): 0.500
NRP Yr cs MEAN DIFFERENCE (m): -0.156
NRP Zr cs MEAN DIFFERENCE (m): 0.059
NRP Xr cs 2-SIGMA DIFFERENCE (m): 0.325
NRP Yr cs 2-SIGMA DIFFERENCE (m): 0.508
NRP Zr cs 2-SIGMA DIFFERENCE (m): 0.253
NRP Xr cs 2-RMS DIFFERENCE (m): 1.052
NRP Yr cs 2-RMS DIFFERENCE (m): 0.596
NRP Zr cs 2-RMS DIFFERENCE (m): 0.279

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xr cs POSITION (m): 96.989
LGRP Yr cs POSITION (m): 5.739

APPROACH #: SU428650
START TIME: 417993.499
STOP TIME: 418113.999

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 9.2
MAXIMUM VDOP: 9.5
AVERAGE VDOP: 9.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***********************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
***********************************************************************

***********************************************************************
* UNSUCCESSFUL APPROACH (POS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN THE VERTICAL FILTER REQUIREMENTS *
***********************************************************************

***********************************************************************
* VALID APPROACH *
***********************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xr cs MEAN DIFFERENCE (m): 0.500
NRP Yr cs MEAN DIFFERENCE (m): -0.156
NRP Zr cs MEAN DIFFERENCE (m): 0.059
NRP Xr cs 2-SIGMA DIFFERENCE (m): 0.325
NRP Yr cs 2-SIGMA DIFFERENCE (m): 0.508
NRP Zr cs 2-SIGMA DIFFERENCE (m): 0.253
NRP Xr cs 2-RMS DIFFERENCE (m): 1.052
NRP Yr cs 2-RMS DIFFERENCE (m): 0.596
NRP Zr cs 2-RMS DIFFERENCE (m): 0.279

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xr cs POSITION (m): 96.989
LGRP Yr cs POSITION (m): 5.739
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428652
START TIME: 418396.249
STOP TIME: 418517.749

MINIMUM HDOP: 2.5
MAXIMUM HDOP: 2.6
AVERAGE HDOP: 2.6

MINIMUM VDOP: 8.0
MAXIMUM VDOP: 8.4
AVERAGE VDOP: 8.2

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY  *
******************************************************************************

******************************************************************************
* VALID APPROACH  *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH  *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.557
NRP Yrcs MEAN DIFFERENCE (m): -0.181
NRP Zrcs MEAN DIFFERENCE (m): 0.083

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.209
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.258
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.197

NRP Xrcs 2-RMS DIFFERENCE (m): 1.134
NRP Yrcs 2-RMS DIFFERENCE (m): 0.445
NRP Zrcs 2-RMS DIFFERENCE (m): 0.258

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 218.954
LGRP Yrcs POSITION (m): -1.106
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428654

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428656
START TIME: 419222.499
STOP TIME: 419338.999

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 5.8
MAXIMUM VDOP: 6.1
AVERAGE VDOP: 6.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

******************************************************************************
* SUCCESSFUL APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.383
NRP Yrcs MEAN DIFFERENCE (m): -0.124
NRP Zrcs MEAN DIFFERENCE (m): 0.060

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.264
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.168
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.291

NRP Xrcs 2-RMS DIFFERENCE (m): 0.811
NRP Yrcs 2-RMS DIFFERENCE (m): 0.300
NRP Zrcs 2-RMS DIFFERENCE (m): 0.315

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 163.272
LGRP Yrcs POSITION (m): -0.365

APPROACH #: SU428656
START TIME: 419222.499
STOP TIME: 419338.999

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 5.8
MAXIMUM VDOP: 6.1
AVERAGE VDOP: 6.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*************************************************

******************************************************************************
* UNSUCCESSFUL APPROACH (MS 1) DUE TO LESS THAN 95 PERCENT OF ALL OF THE DATA POINTS WITHIN THE VERTICAL FILTER REQUIREMENTS *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.383
NRP Yrcs MEAN DIFFERENCE (m): -0.124
NRP Zrcs MEAN DIFFERENCE (m): 0.060

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.264
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.168
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.291

NRP Xrcs 2-RMS DIFFERENCE (m): 0.811
NRP Yrcs 2-RMS DIFFERENCE (m): 0.300
NRP Zrcs 2-RMS DIFFERENCE (m): 0.315

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 163.272
LGRP Yrcs POSITION (m): -0.365
APPROACH #: SU428658
START TIME: 419632.749
STOP TIME: 419755.999

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.5
AVERAGE HDOP: 2.4

MINIMUM VDOP: 4.9
MAXIMUM VDOP: 5.2
AVERAGE VDOP: 5.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.445
NRP Yrcs MEAN DIFFERENCE (m): -0.151
NRP Zrcs MEAN DIFFERENCE (m): 0.124

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.296
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.205
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.224

NRP Xrcs 2-RMS DIFFERENCE (m): 0.939
NRP Yrcs 2-RMS DIFFERENCE (m): 0.366
NRP Zrcs 2-RMS DIFFERENCE (m): 0.334

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 72.744
LGRP Yrcs POSITION (m): 5.606
APPROACH #: SU428660
START TIME: 420597.499
STOP TIME: 420720.249

MINIMUM HDOP: 2.1
MAXIMUM HDOP: 2.1
AVERAGE HDOP: 2.1

MINIMUM VDOP: 3.4
MAXIMUM VDOP: 3.5
AVERAGE VDOP: 3.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

*************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*************************************************

*************************************************
* VALID APPROACH *
*************************************************

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
*************************************************
NRP Xrcs MEAN DIFFERENCE (m): 0.528
NRP Yrcs MEAN DIFFERENCE (m): -0.104
NRP Zrcs MEAN DIFFERENCE (m): -0.102
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.223
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.190
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.240
NRP Xrcs 2-RMS DIFFERENCE (m): 1.079
NRP Yrcs 2-RMS DIFFERENCE (m): 0.262
NRP Zrcs 2-RMS DIFFERENCE (m): 0.315

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
*************************************************
LGRP Xrcs POSITION (m): 324.488
LGRP Yrcs POSITION (m): 0.263
LGRP Zrcs POSITION (m): 0.263

*************************************************
* VALID APPROACH *
*************************************************

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
*************************************************
NRP Xrcs MEAN DIFFERENCE (m): 0.528
NRP Yrcs MEAN DIFFERENCE (m): -0.104
NRP Zrcs MEAN DIFFERENCE (m): -0.102
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.223
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.190
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.240
NRP Xrcs 2-RMS DIFFERENCE (m): 1.079
NRP Yrcs 2-RMS DIFFERENCE (m): 0.262
NRP Zrcs 2-RMS DIFFERENCE (m): 0.315

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
*************************************************
LGRP Xrcs POSITION (m): 324.488
LGRP Yrcs POSITION (m): 0.263
LGRP Zrcs POSITION (m): 0.263

397
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)
APPROACH #: SU428662
START TIME: 421020.249
STOP TIME: 421141.249

MINIMUM HDOP: 5.2
MAXIMUM HDOP: 6.0
AVERAGE HDOP: 5.6

MINIMUM VDOP: 12.3
MAXIMUM VDOP: 14.7
AVERAGE VDOP: 13.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
******************************************************************************

******************************************************************************
* UNSUCCESSFUL APPROACH (MOS 3) DUE TO VIOLATION *
* OF THE VERTICAL TUNNEL BOUNDARY *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.381
NRP Yrcs MEAN DIFFERENCE (m): -0.110
NRP Zrcs MEAN DIFFERENCE (m): 0.128

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.161
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.199
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.247

NRP Xrcs 2-RMS DIFFERENCE (m): 0.779
NRP Yrcs 2-RMS DIFFERENCE (m): 0.297
NRP Zrcs 2-RMS DIFFERENCE (m): 0.355

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 343.499
LGRP Yrcs POSITION (m): 0.201

******************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
******************************************************************************

******************************************************************************
* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *
******************************************************************************

******************************************************************************
* VALID APPROACH *
******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.381
NRP Yrcs MEAN DIFFERENCE (m): -0.110
NRP Zrcs MEAN DIFFERENCE (m): 0.128

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.161
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.199
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.247

NRP Xrcs 2-RMS DIFFERENCE (m): 0.779
NRP Yrcs 2-RMS DIFFERENCE (m): 0.297
NRP Zrcs 2-RMS DIFFERENCE (m): 0.355

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 343.499
LGRP Yrcs POSITION (m): 0.201

401
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

SU428662

NRP Yrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Position (m)

NRP Zrcs Diff (m)
APPROACH #: SU428664
START TIME: 421436.499
STOP TIME: 421552.499

MINIMUM HDOP: 3.7
MAXIMUM HDOP: 4.0
AVERAGE HDOP: 3.8

MINIMUM VDOP: 7.9
MAXIMUM VDOP: 8.8
AVERAGE VDOP: 8.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

* METHOF OF EVALUATION: TOTAL SYSTEM ACCURACY *

* VALID APPROACH *

* SUCCESSFUL APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN (m): 0.660
NRP Yrcs MEAN (m): 0.233
NRP Zrcs MEAN (m): 0.026

NRP Xrcs 2-SIGMA (m): 0.941
NRP Yrcs 2-SIGMA (m): 0.529
NRP Zrcs 2-SIGMA (m): 0.288

NRP Xrcs 2-RMS (m): 1.622
NRP Yrcs 2-RMS (m): 0.706
NRP Zrcs 2-RMS (m): 0.293

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 179.324
LGRP Yrcs POSITION (m): 0.315

APPROACH #: SU428664
START TIME: 421436.499
STOP TIME: 421552.499

MINIMUM HDOP: 3.7
MAXIMUM HDOP: 4.0
AVERAGE HDOP: 3.8

MINIMUM VDOP: 7.9
MAXIMUM VDOP: 8.8
AVERAGE VDOP: 8.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

* METHOF OF EVALUATION: SENSOR ACCURACY *

* UNSUCCESSFUL APPROACH (MOS 1) DUE TO LESS THAN *
* 95 PERCENT OF ALL OF THE DATA POINTS WITHIN *
* THE VERTICAL FILTER REQUIREMENTS *

* VALID APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN (m): 0.660
NRP Yrcs MEAN (m): 0.233
NRP Zrcs MEAN (m): 0.026

NRP Xrcs 2-SIGMA (m): 0.941
NRP Yrcs 2-SIGMA (m): 0.529
NRP Zrcs 2-SIGMA (m): 0.288

NRP Xrcs 2-RMS (m): 1.622
NRP Yrcs 2-RMS (m): 0.706
NRP Zrcs 2-RMS (m): 0.293

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 179.324
LGRP Yrcs POSITION (m): 0.315
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428664

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
APPROACH #: SU428702
START TIME: 494928.499
STOP TIME: 495024.499

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 4.0
MAXIMUM VDOP: 4.0
AVERAGE VDOP: 4.0

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *

* METHOD OF EVALUATION: SENSOR ACCURACY *

USSUCCESSFUL APPROACH (MDS 1) DUE TO LESS THAN * 95 PERCENT OF ALL OF THE DATA POINTS WITHIN * THE VERTICAL FILTER REQUIREMENTS *

VALID APPROACH *

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.371
NRP Yrcs MEAN DIFFERENCE (m): -0.111
NRP Zrcs MEAN DIFFERENCE (m): 0.299
NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.141
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.029
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.255
NRP Xrcs 2-RMS DIFFERENCE (m): 0.555
NRP Yrcs 2-RMS DIFFERENCE (m): 0.319
NRP Zrcs 2-RMS DIFFERENCE (m): 0.324

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 63.126
LGRP Yrcs POSITION (m): -2.705

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 63.126
LGRP Yrcs POSITION (m): -2.705
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP - Zrcs (m) GPS (.), Truth (-)

NRP Yrcs Position (m)

NRP - Zrcs Tot Sys Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428704
START TIME: 495379.999
STOP TIME: 495476.499

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 3.7
MAXIMUM VDOP: 3.7
AVERAGE VDOP: 3.7

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

* VALID APPROACH

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.402
NRP Yrcs MEAN DIFFERENCE (m): -0.116
NRP Zrcs MEAN DIFFERENCE (m): 0.075

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.120
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.152
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.266

NRP Xrcs 2-RMS DIFFERENCE (m): 0.812
NRP Yrcs 2-RMS DIFFERENCE (m): 0.278
NRP Zrcs 2-RMS DIFFERENCE (m): 0.305

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 130.363
LGRP Yrcs POSITION (m): 0.831

APPROACH #: SU428704
START TIME: 495379.999
STOP TIME: 495476.499

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 3.7
MAXIMUM VDOP: 3.7
AVERAGE VDOP: 3.7

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*************************************************

* VALID APPROACH

*************************************************
* SUCCESSFUL APPROACH *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.402
NRP Yrcs MEAN DIFFERENCE (m): -0.116
NRP Zrcs MEAN DIFFERENCE (m): 0.075

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.120
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.152
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.266

NRP Xrcs 2-RMS DIFFERENCE (m): 0.812
NRP Yrcs 2-RMS DIFFERENCE (m): 0.278
NRP Zrcs 2-RMS DIFFERENCE (m): 0.305

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 130.363
LGRP Yrcs POSITION (m): 0.831
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP -Zrcs Position (m)
APPROACH #: SU428706
START TIME: 495787.749
STOP TIME: 495883.999

MINIMUM HDOP: 2.2
MAXIMUM HDOP: 2.2
AVERAGE HDOP: 2.2

MINIMUM VDOP: 3.5
MAXIMUM VDOP: 3.5
AVERAGE VDOP: 3.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

***********************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
***********************

***********************
* METHOD OF EVALUATION: SENSOR ACCURACY *
***********************

***********************
* VALID APPROACH *
***********************

***********************
* SUCCESSFUL APPROACH *
***********************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRPX RCS MEAN DIFFERENCE (m): 0.457
NRPY RCS MEAN DIFFERENCE (m): -0.155
NRPZ RCS MEAN DIFFERENCE (m): 0.089

NRPX RCS 2-SIGMA DIFFERENCE (m): 0.123
NRPY RCS 2-SIGMA DIFFERENCE (m): 0.242
NRPZ RCS 2-SIGMA DIFFERENCE (m): 0.230

NRPX RCS 2-RMS DIFFERENCE (m): 0.921
NRPY RCS 2-RMS DIFFERENCE (m): 0.394
NRPZ RCS 2-RMS DIFFERENCE (m): 0.291

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP XRCs POSITION (m): 128.751
LGRP YRCs POSITION (m): 1.374
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428706:

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428708
START TIME: 496206.999
STOP TIME: 496303.749

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 4.3
MAXIMUM VDOP: 4.4
AVERAGE VDOP: 4.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

**********************************************************************************************************************************************
* VALID APPROACH
**********************************************************************************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.523
NRP Yrcs MEAN DIFFERENCE (m): -0.123
NRP Zrcs MEAN DIFFERENCE (m): 0.118

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.095
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.192
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.246

NRP Xrcs 2-RMS DIFFERENCE (m): 1.050
NRP Yrcs 2-RMS DIFFERENCE (m): 0.312
NRP Zrcs 2-RMS DIFFERENCE (m): 0.341

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 136.857
LGRP Yrcs POSITION (m): -1.208

APPROACH #: SU428708
START TIME: 496206.999
STOP TIME: 496303.749

MINIMUM HDOP: 2.3
MAXIMUM HDOP: 2.3
AVERAGE HDOP: 2.3

MINIMUM VDOP: 4.3
MAXIMUM VDOP: 4.4
AVERAGE VDOP: 4.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*************************************************

**********************************************************************************************************************************************
* VALID APPROACH
**********************************************************************************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.523
NRP Yrcs MEAN DIFFERENCE (m): -0.123
NRP Zrcs MEAN DIFFERENCE (m): 0.118

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.095
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.192
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.246

NRP Xrcs 2-RMS DIFFERENCE (m): 1.050
NRP Yrcs 2-RMS DIFFERENCE (m): 0.312
NRP Zrcs 2-RMS DIFFERENCE (m): 0.341

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 136.857
LGRP Yrcs POSITION (m): -1.208

421
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

SU428708

NRP Xrcs Position (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428708:

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)

NRP Xrcs Position (m)
APPROACH #: SU428710
START TIME: 496631.249
STOP TIME: 496729.249

MINIMUM HDOP: 2.4
MAXIMUM HDOP: 2.4
AVERAGE HDOP: 2.4

MINIMUM VDOP: 4.5
MAXIMUM VDOP: 4.6
AVERAGE VDOP: 4.6

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

********************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
********************************************************************************

********************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
********************************************************************************

********************************************************************************
* VALID APPROACH *
********************************************************************************

********************************************************************************
* SUCCESSFUL APPROACH *
********************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.537
NRP Yrcs MEAN DIFFERENCE (m): -0.172
NRP Zrcs MEAN DIFFERENCE (m): 0.154

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.124
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.266
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.223

NRP Xrcs 2-RMS DIFFERENCE (m): 1.082
NRP Yrcs 2-RMS DIFFERENCE (m): 0.436
NRP Zrcs 2-RMS DIFFERENCE (m): 0.380

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 153.786
LGRP Yrcs POSITION (m): 0.973

425
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

NRP Xrcs Position (m)

NRP Xrcs Diff (m)

NRP Yrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Position (m)

NRP Zrcs Diff (m)
**APPROACH #: SU428712**

**START TIME: 497043.499**

**STOP TIME: 497140.749**

**MINIMUM HDOP: 2.5**

**MAXIMUM HDOP: 2.5**

**AVERAGE HDOP: 2.5**

**MINIMUM VDOP: 4.8**

**MAXIMUM VDOP: 4.9**

**AVERAGE VDOP: 4.9**

**MINIMUM NUMBER OF SVs: 4**

**MAXIMUM NUMBER OF SVs: 4**

**AVERAGE NUMBER OF SVs: 4**

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

<table>
<thead>
<tr>
<th>NRP Xrcs</th>
<th>MEAN DIFFERENCE (m): 0.460</th>
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<tbody>
<tr>
<td>NRP Yrcs</td>
<td>MEAN DIFFERENCE (m): -0.197</td>
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<tr>
<td>NRP Zrcs</td>
<td>MEAN DIFFERENCE (m): 0.111</td>
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<table>
<thead>
<tr>
<th>NRP Xrcs</th>
<th>2-SIGMA DIFFERENCE (m): 0.164</th>
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</thead>
<tbody>
<tr>
<td>NRP Yrcs</td>
<td>2-SIGMA DIFFERENCE (m): 0.302</td>
</tr>
<tr>
<td>NRP Zrcs</td>
<td>2-SIGMA DIFFERENCE (m): 0.230</td>
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<table>
<thead>
<tr>
<th>NRP Xrcs</th>
<th>2-RMS DIFFERENCE (m): 0.934</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRP Yrcs</td>
<td>2-RMS DIFFERENCE (m): 0.497</td>
</tr>
<tr>
<td>NRP Zrcs</td>
<td>2-RMS DIFFERENCE (m): 0.319</td>
</tr>
</tbody>
</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>LGRP Xrcs POSITION (m): 182.509</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGRP Yrcs POSITION (m): 0.663</td>
</tr>
</tbody>
</table>

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>LGRP Xrcs POSITION (m): 182.509</th>
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<tr>
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</tbody>
</table>
APPROACH #: SU428714
START TIME: 497492.749
STOP TIME: 497593.499

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.5
AVERAGE VDOP: 5.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*******************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*******************************************************************************

*******************************************************************************
* VALID APPROACH *
*******************************************************************************

*******************************************************************************
* SUCCESSFUL APPROACH *
*******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
---------------------------------------------------

NRPXrcs MEAN DIFFERENCE (m): 0.666
NRPXrcs MEAN DIFFERENCE (m): 0.363
NRPXrcs 2-SIGMA DIFFERENCE (m): 0.363
NRPXrcs 2-SIGMA DIFFERENCE (m): 0.201
NRPXrcs 2-RMS DIFFERENCE (m): 1.380
NRPXrcs 2-RMS DIFFERENCE (m): 0.331
NRPXrcs 2-RMS DIFFERENCE (m): 0.340

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
---------------------------------------------------

LGRP Xrcs POSITION (m): 117.852
LGRP Yrcs POSITION (m): -0.045

APPROACH #: SU428714
START TIME: 497492.749
STOP TIME: 497593.499

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.5
AVERAGE VDOP: 5.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*******************************************************************************
* METHOD OF EVALUATION: SENSOR ACCURACY *
*******************************************************************************

*******************************************************************************
* VALID APPROACH *
*******************************************************************************

*******************************************************************************
* SUCCESSFUL APPROACH *
*******************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT
---------------------------------------------------

NRPXrcs MEAN DIFFERENCE (m): 0.666
NRPXrcs MEAN DIFFERENCE (m): 0.363
NRPXrcs 2-SIGMA DIFFERENCE (m): 0.363
NRPXrcs 2-SIGMA DIFFERENCE (m): 0.201
NRPXrcs 2-RMS DIFFERENCE (m): 1.380
NRPXrcs 2-RMS DIFFERENCE (m): 0.331
NRPXrcs 2-RMS DIFFERENCE (m): 0.340

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION
---------------------------------------------------

LGRP Xrcs POSITION (m): 117.852
LGRP Yrcs POSITION (m): -0.045
APPROACH #: SU428720
START TIME: 499610.499
STOP TIME: 499709.499

MINIMUM HDOP: 2.7
MAXIMUM HDOP: 2.7
AVERAGE HDOP: 2.7

MINIMUM VDOP: 5.3
MAXIMUM VDOP: 5.3
AVERAGE VDOP: 5.3

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

LGRP Xccs POSITION (m): 154.243
LGRP Yccs POSITION (m): 0.252
NRP POSITION vs 95% TUNNEL

NRP TOTAL SYSTEM POSITION DIFF

NRP Xrcs Position (m)

NRP Yrcs Position (m) GPS (.), Truth (-)

NRP Yrcs Tot Sys Diff (m)

NRP Zrcs Position (m)

NRP Zrcs Tot Sys Diff (m)
APPROACH #: SU428722
START TIME: 500032.999
STOP TIME: 500131.749

MINIMUM HDOP: 2.8
MAXIMUM HDOP: 2.8
AVERAGE HDOP: 2.8

MINIMUM VDOP: 5.4
MAXIMUM VDOP: 5.4
AVERAGE VDOP: 5.4

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

*****************************************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
*****************************************************************************

*****************************************************************************
* VALID APPROACH *
*****************************************************************************

*****************************************************************************
* SUCCESSFUL APPROACH *
*****************************************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.575
NRP Yrcs MEAN DIFFERENCE (m): -0.269
NRP Zrcs MEAN DIFFERENCE (m): 0.052

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.197
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.366
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.280

NRP Xrcs 2-RMS DIFFERENCE (m): 1.167
NRP Yrcs 2-RMS DIFFERENCE (m): 0.651
NRP Zrcs 2-RMS DIFFERENCE (m): 0.299

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 140.551
LGRP Yrcs POSITION (m): -1.153
PATH FOLLOWING ERROR

CONTROL MOTION NOISE

E 20
0
W -10
w -20
-6000
-4000 -2000 0
E
v
O
L.
Z
O
J
10
5
0
-5
I1
0
-NR Xrcs Position (m)

-4000 -2000 0
-6000
-10
-5
0
5
10
-NR Xrcs Position (m)
APPROACH #: SU428724
START TIME: 500462.999
STOP TIME: 500563.249

MINIMUM HDOP: 2.9
MAXIMUM HDOP: 2.9
AVERAGE HDOP: 2.9

MINIMUM VDOP: 5.5
MAXIMUM VDOP: 5.5
AVERAGE VDOP: 5.5

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

****************************************************
* METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY *
****************************************************

****************************************************
* VALID APPROACH *
****************************************************

****************************************************
* SUCCESSFUL APPROACH *
****************************************************

TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT

NRP Xrcs MEAN DIFFERENCE (m): 0.709
NRP Yrcs MEAN DIFFERENCE (m): -0.167
NRP Zrcs MEAN DIFFERENCE (m): 0.118

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.369
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.256
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.260

NRP Xrcs 2-RMS DIFFERENCE (m): 1.466
NRP Yrcs 2-RMS DIFFERENCE (m): 0.421
NRP Zrcs 2-RMS DIFFERENCE (m): 0.351

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 153.991
LGRP Yrcs POSITION (m): -1.268
PATH FOLLOWING ERROR

SU428724

CONTROL MOTION NOISE

NRP Xrcs Position (m)

Lateral PFE Filter Output (m)

Lateral CMN Filter Output (m)

Vertical PFE Filter Output (m)

Vertical CMN Filter Output (m)
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428724

NRP Xrcs Position (m)

NRP Yrcs Position (m)

NRP Zrcs Position (m)
APPROACH #: SU428730
START TIME: 501793.749
STOP TIME: 501896.999

MINIMUM HDOP: 3.5
MAXIMUM HDOP: 3.6
AVERAGE HDOP: 3.6

MINIMUM VDOP: 6.7
MAXIMUM VDOP: 6.9
AVERAGE VDOP: 6.8

MINIMUM NUMBER OF SVs: 4
MAXIMUM NUMBER OF SVs: 4
AVERAGE NUMBER OF SVs: 4

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

NRP Xrcs MEAN DIFFERENCE (m): 0.589
NRP Yrcs MEAN DIFFERENCE (m): -0.164
NRP Zrcs MEAN DIFFERENCE (m): 0.089

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.242
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.378
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.275

NRP Xrcs 2-RMS DIFFERENCE (m): 1.202
NRP Yrcs 2-RMS DIFFERENCE (m): 0.501
NRP Zrcs 2-RMS DIFFERENCE (m): 0.328

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 128.892
LGRP Yrcs POSITION (m): -0.268

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

NRP Xrcs MEAN DIFFERENCE (m): 0.569
NRP Yrcs MEAN DIFFERENCE (m): -0.164
NRP Zrcs MEAN DIFFERENCE (m): 0.089

NRP Xrcs 2-SIGMA DIFFERENCE (m): 0.242
NRP Yrcs 2-SIGMA DIFFERENCE (m): 0.378
NRP Zrcs 2-SIGMA DIFFERENCE (m): 0.275

NRP Xrcs 2-RMS DIFFERENCE (m): 1.202
NRP Yrcs 2-RMS DIFFERENCE (m): 0.501
NRP Zrcs 2-RMS DIFFERENCE (m): 0.328

LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION

LGRP Xrcs POSITION (m): 128.892
LGRP Yrcs POSITION (m): -0.268
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428730:

NRP Xrcs Position (m)

NRP Yrcs Diff (m)

NRP Zrcs Diff (m)
**APPROACH #: SU428734**

**START TIME:** 502642.499  
**STOP TIME:** 502746.499

- **MINIMUM HDOP:** 4.0  
- **MAXIMUM HDOP:** 4.0  
- **AVERAGE HDOP:** 4.0

- **MINIMUM VDOP:** 8.8  
- **MAXIMUM VDOP:** 9.1  
- **AVERAGE VDOP:** 9.0

- **MINIMUM NUMBER OF SVs:** 4  
- **MAXIMUM NUMBER OF SVs:** 4  
- **AVERAGE NUMBER OF SVs:** 4

---

**TIME HISTORY ANALYSIS FROM 200 ft HAT -> ROLL-OUT**

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<thead>
<tr>
<th>Component</th>
<th>Mean Difference (m)</th>
<th>2-Sigma Difference (m)</th>
<th>2-RMS Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xrcs MEAN DIFFERENCE (m)</td>
<td>0.659</td>
<td>0.391</td>
<td>1.375</td>
</tr>
<tr>
<td>Yrcs MEAN DIFFERENCE (m)</td>
<td>-0.087</td>
<td>0.197</td>
<td>0.263</td>
</tr>
<tr>
<td>Zrcs MEAN DIFFERENCE (m)</td>
<td>0.172</td>
<td>0.288</td>
<td>0.449</td>
</tr>
<tr>
<td>Xrcs 2-SIGMA DIFFERENCE (m)</td>
<td>0.659</td>
<td>0.391</td>
<td>1.375</td>
</tr>
<tr>
<td>Yrcs 2-SIGMA DIFFERENCE (m)</td>
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<td>0.659</td>
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<td>1.375</td>
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<tr>
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<td>0.172</td>
<td>0.288</td>
<td>0.449</td>
</tr>
</tbody>
</table>

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**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>Component</th>
<th>Position (m)</th>
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<tr>
<td>LGRP Xrcs</td>
<td>99.080</td>
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<tr>
<td>LGRP Yrcs</td>
<td>0.007</td>
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---

**METHOD OF EVALUATION: TOTAL SYSTEM ACCURACY**

**VALID APPROACH**

---

**METHOD OF EVALUATION: SENSOR ACCURACY**

**VALID APPROACH**

---

**LANDING GEAR REFERENCE POINT TOUCHDOWN POSITION**

<table>
<thead>
<tr>
<th>Component</th>
<th>Position (m)</th>
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<tr>
<td>LGRP Xrcs</td>
<td>99.080</td>
</tr>
<tr>
<td>LGRP Yrcs</td>
<td>0.007</td>
</tr>
</tbody>
</table>
NRP LONGITUDINAL, LATERAL & VERTICAL UNFILTERED POSITION DIFFERENCES

SU428734:

NRP X RCS Position (m)

NRP Xcs Diff (m)

NRP Y RCS Position (m)

NRP Ycs Diff (m)

NRP Z RCS Position (m)

NRP Zcs Diff (m)
APPENDIX D

LASER TRACKER BIAS CORRECTION PLOTS
SU4284

Laser Elevation Mean Error (rad)

GPS Time (sec) x 10^5

Laser Zcos Mean Error (m)

GPS Time (sec) x 10^5

461
SU4286

Laser Range Mean Error (m)

GPS Time (sec) x 10^5

Laser Xros Mean Error (m)

GPS Time (sec) x 10^5
SU4286

Laser Elevation Mean Error (rad)

GPS Time (sec) x 10^5

Laser Zcs Mean Error (m)

GPS Time (sec) x 10^5
SU4287

Laser Range Mean Error (m)

Laser Xecs Mean Error (m)

GPS Time (sec) $\times 10^5$
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<th>Abbreviation</th>
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<td>CAT</td>
<td>Category</td>
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<td>Center of Gravity</td>
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<tr>
<td>CMN</td>
<td>Control Motion Noise</td>
</tr>
<tr>
<td>CTOL</td>
<td>Conventional Take-Off and Landing Aim Point</td>
</tr>
<tr>
<td>DGPS</td>
<td>Differential Global Positioning System</td>
</tr>
<tr>
<td>EOR</td>
<td>End of Runway</td>
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<tr>
<td>FAA</td>
<td>Federal Aviation Administration</td>
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<tr>
<td>FAF</td>
<td>Final Approach Fix</td>
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<td>GS</td>
<td>Glide Slope</td>
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<tr>
<td>HAT</td>
<td>Height Above Threshold</td>
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<tr>
<td>HDOP</td>
<td>Horizontal Dilution of Precision</td>
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<td>IAF</td>
<td>Initial Approach Fix</td>
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<tr>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
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<td>Instrument Landing System</td>
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<td>Lateral Control Motion Noise</td>
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<td>LFTE</td>
<td>Lateral Flight Technical Error</td>
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<td>Landing Gear Reference Point</td>
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<td>LPFE</td>
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<td>Lateral Total System Error Estimate</td>
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<td>Mean Sea Level</td>
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<td>Navigation Reference Point</td>
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<td>PFE</td>
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<td>RCLTSE</td>
<td>Rollout Control Lateral Total System Error</td>
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<td>Runway Coordinate System</td>
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<td>Required Navigation Performance</td>
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<td>VMC</td>
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<td>Yrcs</td>
<td>Runway Coordinate System Y Direction</td>
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<td>Zrcs</td>
<td>Runway Coordinate System Z Direction</td>
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<tr>
<td>luI+2SIG</td>
<td>Mean Absolute Value + Two Sigma Standard Deviation</td>
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<td>Two Root Mean Square</td>
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<tr>
<td>2SIGUCL</td>
<td>Two Sigma Standard Deviation Upper Confidence Level</td>
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<td>95th Percentile</td>
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**Title and Subtitle:** Flight Test Evaluation of the Stanford University/United Airlines Differential GPS Category III Automatic Landing System

**Authors:** David N. Kaufmann and B. David McNally

**Performing Organization:**
Ames Research Center
Moffett Field, CA 94035-1000

**Funding Numbers:** 505-64-13

**Performing Organization Report Number:** A-950066

**Sponsoring/Monitoring AGENCY NAME(S) AND ADDRESS(ES):**
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**Sponsor/Monitoring AGENCY REPORT NUMBER:** NASA TM-110354

**Supplemental Notes:**
Point of Contact: David Kaufmann, Ames Research Center, MS N210-9, Moffett Field, CA 94035-1000; (415) 604-5440

**Abstract:**
Test flights were conducted to evaluate the capability of Differential Global Positioning System (DGPS) to provide the accuracy and integrity required for International Civil Aviation Organization (ICAO) Category (CAT) III precision approach and landings. These test flights were part of a Federal Aviation Administration (FAA) program to evaluate the technical feasibility of using DGPS based technology for CAT III precision approach and landing applications.

A United Airlines Boeing 737-300 (N304UA) was equipped with DGPS receiving equipment and additional computing capability provided by Stanford University. The test flights were conducted at NASA Ames Research Center’s Crows Landing Flight Facility, Crows Landing, California. The flight test evaluation was based on completing 100 approaches and autolandings; 90 touch and go, and 10 terminating with a full stop. Two types of accuracy requirements were evaluated: 1) Total system error, based on the Required Navigation Performance (RNP), and 2) Navigation sensor error, based on ICAO requirements for the Microwave Landing System (MLS).

All of the approaches and autolandings were evaluated against ground truth reference data provided by a laser tracker. Analysis of these approaches and autolandings shows that the Stanford University/United Airlines system met the requirements for a successful approach and autolanding 98 out of 100 approaches and autolandings, based on the total system error requirements as specified in the FAA CAT III Level 2 Flight Test Plan.

**Subject Terms:**
DGPS automatic landing system

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