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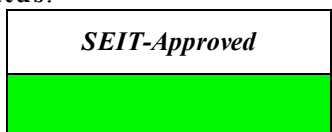
Deliverable Number: FT002

Title: CCA Test Objectives

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Abstract: Three sources have been considered to provide information allowing the evaluation of the Collision Conflict Avoidance (CCA) functional requirements: existing data, simulation, and flight test. The existing data sources that have been evaluated have been found to be lacking in two areas: The actual data that was recorded and missing elements to the system architecture. Many previous tests addressing collision avoidance were conducted without a remote operator. As such, they are missing critical elements that are required to assess the CCA functional requirements. Tests such as ERAST were conducted with all of the UAS elements. However, ERAST tests were conducted as a demonstration and the data recorded was of end-to-end performance. Many contributing elements of the system were not individually recorded or were recorded at a data rate insufficient for the purposes of evaluating the CCA functional requirements.

Status:

SEIT-Approved

Limitations on use: This document represents thoughts and ideas of the Flight IPT work package team. It has not been reviewed or approved as an Access 5 project position on this subject. In addition to SEIT review and comment, the information also needs substantiation through simulation/flight demonstrations.

The CCA work package has elected to use simulation as their primary tool for evaluating their functional requirements. The simulation will contain all of the required elements for a proper evaluation. Likewise, the precise data required will be gathered with sufficient fidelity to allow an appropriate evaluation of the functional requirements.

Simulation data is only as good as the fidelity of the simulator. To validate the CCA simulation requires much of the same type of data that was found lacking in the existing data sets. Therefore, flight test will be used to gather data under select conditions to allow validation of the CCA simulation.

Flight IPT CCA Test Objectives
Access 5
8-31-05

Approved by: _____

Jim Evans, Technology Integrated Product Team Lead

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Tony Ginn, Flight Integrated Product Lead

Background

The CCA WP is responsible for evaluating the CCA functional requirements document. To perform this, the CCA WP has established the following objectives:

Revised CCA Objectives, 22 Mar 05

Approved by Jim Evans/Tech IPT and Tony Ginn/Flight IPT on 23 Mar 05

- **CGTO-1**: Demonstrate the ability to detect cooperative traffic and provide situational awareness to the ROA pilot.
    - STO-1.1: Determine the detection range and Minimum Detect Time[1] provided by the CCA subsystem. [CCA FRD 2.6.1][2]
    - STO-1.2: Determine the effective azimuth Field-of-Regard and azimuth accuracy of the CCA subsystem. [CCA FRD 2.6.2]
    - STO-1.3: Determine the effective elevation Field-of-Regard and elevation accuracy of the CCA subsystem. [CCA FRD 2.6.3]
    - STO-1.4: Demonstrate the capability of the CCA subsystem to detect multiple threat aircraft. [CCA FRD 2.6]

- **CGTO-2**: Demonstrate the ability to track the detected cooperative traffic and provide position information to the ROA pilot.
    - STO-2.1: Demonstrate that the time and position information of cooperative aircraft is tracked and presented to the ROA pilot. [CCA FRD 2.7.1]
    - STO-2.2: Demonstrate that tracks of multiple threat aircraft are presented to the ROA pilot. [CCA FRD 2.7.2]
    - STO-2.3: Determine the track accuracy of the time and position information collected on the cooperative threat aircraft. [CCA FRD 2.7.4]

- **CGTO-3**: Demonstrate the ability to determine collision potential with detected cooperative traffic and provide notification to the ROA pilot.
    - STO-3.1: Observe the information presented to the ROA pilot that conveys collision potential. [CCA FRD 2.8.1 & 2.8.2]
    - STO-3.2: Demonstrate the utility of the CCA subsystem alert that notifies the ROA pilot of a potential collision threat. [CCA FRD 2.8.2]

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[1] According to the "*Sense and Avoid ELOS Definition v9*", Minimum Detect Time is defined as the time from detection of an intruder until the completion of an evasion maneuver (functions F2 through F6). In other words, the system must provide sufficient time after intruder detection for performance of all remaining collision avoidance functions resulting in successful execution of an avoidance maneuver if necessary.

[2] As referenced against CCA Functional Requirements Document (FRD), Rev 3

- **CGTO-4**: Demonstrate that the CCA subsystem provides information in sufficient time for the ROA pilot to initiate an evasive maneuver to avoid collision.
    - STO-4.1: Demonstrate that the CCA subsystem alarm is provided in sufficient time for the ROA pilot to initiate an evasive maneuver. [CCA FRD 2.9.1]
    - STO-4.2: Demonstrate the utility of a CCA subsystem recommended evasive maneuver. [CCA FRD 2.9.2 & 2.9.3]

- **CGTO-5**: Demonstrate an evasive maneuver that avoids collision with the threat aircraft.
    - STO-5.1: Determine the time required for the ROA pilot to perform an evasive maneuver after the CCA subsystem has notified the ROA pilot of a potential collision. [CCA FRD 2.6.1]
    - STO-5.2: Demonstrate that the evasive maneuver is within the performance limitations of the ROA. [CCA FRD 2.4]
    - STO-5.3: Demonstrate that the evasive maneuver resolves the collision threat without creating another collision threat with nearby aircraft. [CCA FRD 2.9.6]

- **CGTO-6**: Demonstrate the ability to assess the adequacy of the maneuver and determine that the collision potential has been avoided.
    - STO-6.1: Determine that the evasive maneuver maintains separation from the threat aircraft. [CCA FRD 2.10.1]
    - STO-6.2: Demonstrate that the ROA pilot can determine when the ROA is clear of conflicting traffic. [CCA FRD 2.10.1]

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CCA Flight Test Objectives

The general test objective for the CCA technology demonstration flight test is to:

- **FGTO-1**: Collect data to validate the CCA simulation.
    - from the threat aircraft. [CCA FRD 2.10.1]

    This can be broken into the following specific test objectives:

    - **FSTO-1**   Collect data to validate CCA sensor models.

    - **FSTO-2**   Collect data to validate link affect models on the transmission of CCA sensor data.

    - **FSTO-3**   Collect data to validate the CCA display.

    - **FSTO-4**   Collect data to validate operator response to the CCA display.

    - **FSTO-5**   Collect data to validate link affect models on the transmission of operator evasion commands to the vehicle.

    - **FSTO-6**   Validate the vehicle model during an evasion maneuver.

    - **FSTO-7**   Collect data to validate the resulting miss distance between the UAS and intruder during a collision avoidance scenario.

FTGO – Flight (test) General Test Objective

FSTO – Flight (test) Specific Test Objective