TIMS PERFORMANCE EVALUATION SUMMARY

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1. PURPOSE

The purpose of this effort was to investigate the TIMS operation under various conditions to determine what effect, if any, there is on the TIMS performance. This effort was undertaken because of reports from investigators that the TIMS is not performing as expected when flown on the ARC C-130. This effort was initiated with a meeting at SSC with representatives from SSC, JPL and ARC.

2. PROBLEM DEFINITION

The problem with the TIMS performance on the C-130 has been characterized in different ways. The primary problem seems to be as follows: Given a blackbody temperature reading from the blackbody controller, different digital count values can be obtained from the blackbody surface as measured by the TIMS, under different conditions encountered on the C-130. These differences result in incorrect surface temperatures computed from the data. Surface temperatures computed from TIMS data collected on the C-130 can be as much as 5C different than the ground truth data.

3. EXPERIMENTAL PLAN

A series of experiments were planned which would systematically illuminate possible conditions which have a measurable effect on the TIMS performance. The hypothesis was that ambient temperature and wind blast on the surface of the TIMS blackbodies was affecting the TIMS performance on the C-130.

The first experiment was a flight test with the TIMS installed on the SSC Learjet. The hypothesis was that ambient temperature and wind blast would affect the TIMS performance. Five flights at different altitudes were made over a large body of water. The data was distributed to three different investigators for analysis. A detailed analysis of the data is found in "A Quantitative Analysis of TIMS Data Obtained on the SSC/Learjet 23 at Various Altitudes.",S. Jaggi, and "TIMS Performance Evaluation Flight Over Ross P. Barnett Reservoir in the Pre-Dawn Hours of 1

February 1992",Palluconi,et.al.

The second experiment involved simulating wind blast on the surface of the TIMS blackbodies while the TIMS was operated in the lab. The hypothesis was that wind blast on the surface of the blackbodies, at various speeds and orientations would affect the TIMS performance. A detailed analysis of the data is found in "Analysis of TIMS Performance Subjected to Simulated Wind Blast",Jaggi,Kuo.

A third experiment is planned if necessary. This experiment will be to define a flight experiment on the C-130. This experiment will include measurement of environmental conditions at the TIMS entrance aperture.

4. FLIGHT TEST RESULTS SUMMARY

Beginning at 3AM CST, five flights were flown in sequence at altitudes of 2Km, 6Km, 12Km, 6Km, and 2Km over the Ross Barnett Reservoir near Jackson, MS. Radio-sonde data and water surface temperatures were acquired. Surface temperatures were acquired with both mercury thermometers and with a hand held radiometer. These measurements differed by approximately 2C over all the sample points.

The TIMS data used in the initial analysis were the high and low temperature outputs from the blackbody controller, the high and low digital counts from the surface of the blackbodies, and the temperature outputs from the two ambient temperature monitors on the TIMS. One of the ambient temperature monitors was located in the TIMS entrance aperture near the high blackbody and the other was attached to the outside of the spectrometer housing.

The four parameters obtained from the blackbodies were used to compute the slope and offset of the System Transfer Equation(STE). The ambient temperature measurements were compared to the data from each altitude. Surface temperatures were computed from the video data independently by each investigator. Each investigator chose to use different techniques to compute surface temperature.

The blackbody parameters and the ambient temperatures have been compared for the different altitudes. The computed temperatures have been

compared to the ground truth data for the different altitudes. The temperature differential between the TIMS data and the ground truth data does not exceed 2C. The blackbody parameters, ambient temperature measurements and different altitudes show no significant correlation. Therefore the original hypothesis has been found to be false, i.e., when the TIMS is operated on the SSC Learjet, there are no measurable effects on TIMS performance due to ambient temperature or wind blast on the surface of the blackbodies.

5. TIMS LABORATORY WIND ANALYSIS RESULTS SUMMARY

The TIMS was operated in the lab with various configurations of wind directed at the surface of the blackbodies. At the time of this writing a maximum wind velocity of 40mph was achieved. Below approximately 30mph, very little effect was observed in TIMS performance. However, with wind speeds of 40mph, the TIMS continued to perform as designed. The data collected did not support the hypothesis that wind blast on the surface of the blackbodies under lab conditions adversely affected the TIMS performance.

6. TIMS PERFORMANCE ANALYSIS RESULTS SUMMARY

The data collected during these experiments indicates that the TIMS is a robust instrument. It can be operated under a wide range of conditions and still perform within its design goals.

At this time, it has not yet been determined if the experiments described above are sufficient to predict the performance of the TIMS on the ARC C-130. The third experiment has not yet been performed. It is believed that given a carefully defined and executed data acquisition mission, the TIMS can and will produce useful data when flown on the C-130.