Flight Test Results from the Rake Airflow Gage Experiment on the F-15B

The primary goal is to identify the relationship between free stream and local mach number in the low supersonic regime.

Dryden Flight Research Center, Edwards, California

The results are described of the Rake Airflow Gage Experiment (RAGE), which was designed and fabricated to support the flight test of a new supersonic inlet design using Dryden's Propulsion Flight Test Fixture (PFTF) and F-15B testbed airplane (see figure). The PFTF is a unique pylon that was developed for flight-testing propulsion-related experiments such as inlets, nozzles, and combustors over a range of subsonic and supersonic flight conditions.

The objective of the RAGE program was to quantify the local flowfield at the aerodynamic interface plane of the Channeled Centerbody Inlet Experiment (CCIE). The CCIE is a fixed representation of a conceptual mixed-compression supersonic inlet with a translating biconic centerbody. The primary goal of RAGE was to identify the relationship between free-stream and local Mach number in the low supersonic regime, with emphasis on the identification of the particular free-stream Mach number that produced a local Mach number of 1.5. Measurements of the local flow angularity, total pressure distortion, and dynamic pressure over the interface plane were also desired.

The experimental data for the RAGE program were obtained during two separate research flights. During both flights,

The **NASA Dryden F-15B** research test bed with Propulsion Flight Test Fixture pylon and Rake Airflow Gage Experiment rake during flight test.

local flowfield data were obtained during straight and level acceleration segments out to steady-state test points. The data obtained from the two flights showed small variations in Mach number, flow angularity, and dynamic pressure across the interface plane at all flight conditions. The data show that a free-stream Mach number of 1.65 will produce the desired local Mach number of 1.5 for CCIE. The local total pressure distortion over the interface plane at this condition was approximately 1.5%. At this condition, there was an average of nearly 2° of downwash over the interface plane. This small amount of downwash is not expected to adversely affect the performance of the CCIE inlet.

This work was done by Michael Frederick and Nalin Ratnayake of Dryden Flight Research Center. Further information is contained in a TSP (see page 1). DRC-009-018

Telemetry and Science Data Software System

Goddard Space Flight Center, Greenbelt, Maryland

The Telemetry and Science Data Software System (TSDSS) was designed to validate the operational health of a spacecraft, ease test verification, assist in debugging system anomalies, and provide trending data and advanced science analysis. In doing so, the system parses, processes, and organizes raw data from the Aquarius instrument both on the ground and while in space. In addition, it provides a user-friendly telemetry viewer, and an instant push-button test report generator. Existing ground data systems can parse and provide simple data processing, but have limitations in advanced science analysis and instant report generation.

The TSDSS functions as an offline data analysis system during I&T (integration and test) and mission operations phases. After raw data are downloaded from an instrument, TSDSS ingests the data files, parses, converts telemetry to engineering units, and applies advanced algorithms to produce science level 0, 1, and 2 data products. Meanwhile, it automatically schedules upload of the raw data to a remote server and archives all intermediate and final values in a MySQL database in time

order. All data saved in the system can be straightforwardly retrieved, exported, and migrated.

Using TSDSS's interactive data visualization tool, a user can conveniently choose any combination and mathematical computation of interesting telemetry points from a large range of time periods (life cycle of mission ground data and mission operations testing), and display a graphical and statistical view of the data. With this graphical user interface (GUI), the data queried graphs can be exported and saved in multiple formats. This GUI is especially useful in trending data analysis, debugging anomalies, and advanced data analysis. At the request of the user, mission-specific instrument performance assessment reports can be generated with a simple click of a button on the GUI.

From instrument level to observatory level, the TSDSS has been operating supporting functional and performance tests and refining system calibration algorithms and coefficients, in sync with the Aquarius/SAC-D spacecraft. At the time of this reporting, it was prepared and set up to perform anomaly investigation for mission operations preceding the Aquarius/SAC-D spacecraft launch on June 10, 2011.

This work was done by Lakesha Bates and Liang Hong of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16035-1

❯ CropEx Web-Based Agricultural Monitoring and Decision Support
Changes in crop health are monitored over time.

Stennis Space Center, Mississippi

CropEx is a Web-based agricultural Decision Support System (DSS) that monitors changes in crop health over time. It is designed to be used by a wide range of both public and private organizations, including individual producers and regional government offices with a vested interest in tracking vegetation health. The database and data management system automatically retrieve and ingest data for the area of interest. Another stores results of the processing and supports the DSS. The processing engine will allow server-side analysis of imagery with support for image sub-setting and a set of core raster operations for image classification, creation of vegetation indices, and change detection.

The system includes the Web-based (CropEx) interface, data ingestion system, server-side processing engine, and a database processing engine. It contains a Web-based interface that has multi-tiered security profiles for multiple users. The interface provides the ability to identify areas of interest to specific users, user profiles, and methods of processing and data types for selected or created areas of interest. A compilation of programs is used to ingest available data into the system, classify that data, profile that data for quality, and make data available for the processing engine immediately upon the data's availability to the system (near real time).

The processing engine consists of methods and algorithms used to process the data in a real-time fashion without copying, storing, or moving the raw data. The engine makes results available to the database processing engine for storage and further manipulation. The database processing engine ingests data from the image processing engine, distills those results into numerical indices, and stores each index for an area of interest. This process happens each time new data is ingested and processed for the area of interest, and upon subsequent database entries, the database processing engine qualifies each value for each area of interest and conducts a logical processing of results indicating when and where thresholds are exceeded. Reports are provided at regular, operator-determined intervals that include variances from thresholds and links to view raw data for verification, if necessary.

The technology and method of development allow the code base to easily be modified for varied use in the real-time and near-real-time processing environments. In addition, the final product will be demonstrated as a means for rapid draft assessment of imagery.

This work was done by Craig Harvey and Joel Lawhead of Stennis Space Center.

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❯ High-Performance Data Analysis Tools for Sun-Earth Connection Missions
Applications include medical image analysis, hyperspectral imaging, wildlife tracking, and sensor data processing.

Goddard Space Flight Center, Greenbelt, Maryland

The data analysis tool of choice for many Sun-Earth Connection missions is the Interactive Data Language (IDL) by ITT VIS. The increasing amount of data produced by these missions and the increasing complexity of image processing algorithms requires access to higher computing power. Parallel computing is a cost-effective way to increase the speed of computation, but algorithms often-times have to be modified to take advantage of parallel systems. Enhancing IDL to work on clusters gives scientists access to increased performance in a familiar programming environment. The goal of this project was to enable IDL applications to benefit from both computing clusters as well as graphics processing