



MATLAB Developed Applications for High Frequency Data Analysis

MATLAB and Simulink
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Overview

- Optical Sciences Corporation (OSCorp) personnel have combined over 100 years experience supporting NASA projects, primarily in the area of high speed data acquisition and analysis of turbo-pump high-frequency data.
- OSCorp's main NASA customers are responsible for the verification and acceptance of rotating propulsion elements for flight (including components on the Space Shuttle and all future vehicles).
- Since 1985, NASA and contractor engineers have been developing and utilizing a mixture of C and Fortran software on a Unix-based Sun Microsystems Computer to process and analyze all high frequency data.
- As desktop computer processing capabilities become faster, the need for expensive workstations become less desirable. Also, as new engineers are beginning to move away from C and Fortran, software development, maintenance and upgrades are becoming more difficult.

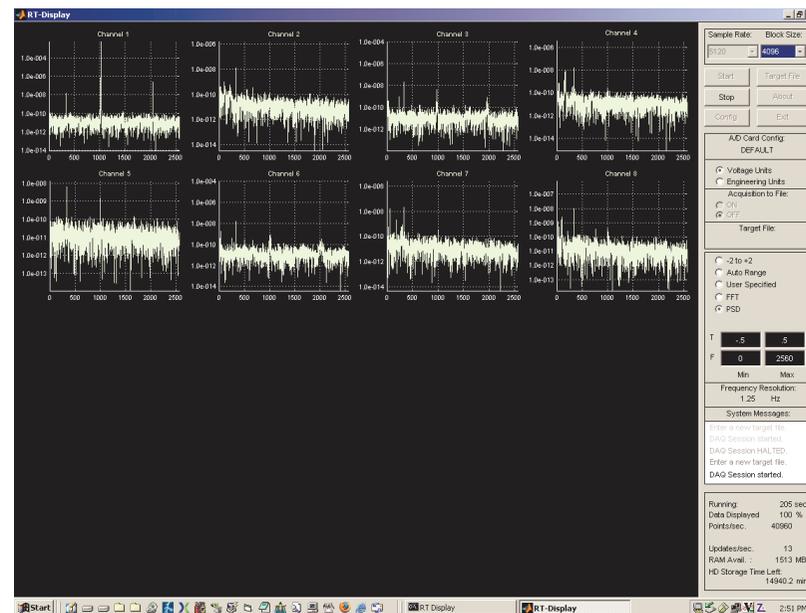
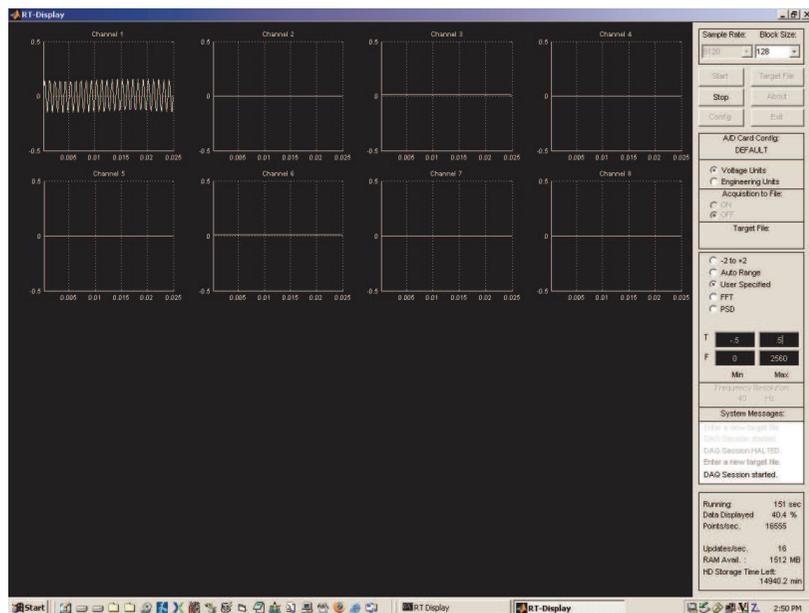
Product Evaluation and Selection

- In 2003, OSCorp began evaluating software development packages that could replace our current Real-Time and post-test analysis capabilities. The goal was multi-faceted for the following reasons:
 - » Move software development platform to a single language that could be developed by multiple software engineers.
 - » Deployable to different operating systems (Windows, Linux and Macintosh).
 - » Create an intuitive analysis tool that would greatly decrease learning curves for new engineers.
 - » Meet all current requirements, yet have greater potential for implementation of advanced algorithms.

- After exhaustive analysis of several software packages, OSCorp selected MATLAB as the new development platform for the replacement of all Real-Time and post-test analysis software.
 - » RT Display™ was the first tool OSCorp developed and is used to setup and control Agilent data acquisition hardware. The tool allows the user to visually display Real-Time data in both frequency and time domain.
 - » Plotypus™ is OSCorp's MATLAB based processing, analysis and plotting package that is currently being developed and will replace all of the post-test analysis software.

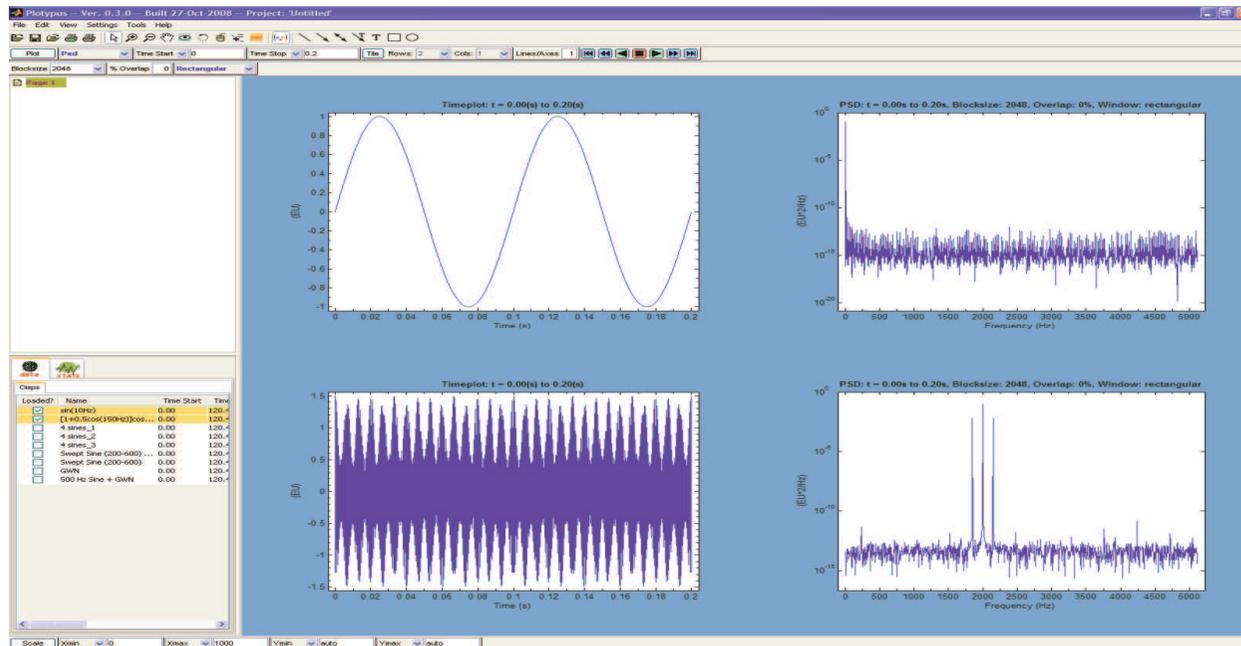
RT Display™ Analysis Tool

- RT Display™ is currently being used to support various testing at Marshall Space Flight Center (MSFC) at Test Stand 500 in the East Test Area and at both the waterflow and airflow facilities in building 4707. It is also used at Stennis Space Center for setup and channelization of the Multi-channel Integrated Dynamic Data Acquisition Systems (MIDDAS) used for Space Shuttle Main Engine Testing. RT Display™ is currently used by approximately 15 engineers and technicians from 3 different groups across two NASA centers.



Plotypus™ Processing and Analysis Tool

- Plotypus™ is currently being developed and is in a beta release format. Initial development has focused on the basic processing and analysis tools. These tools allow users to analyze high frequency data and generate electronic or paper packages for NASA reviews. It will be used primarily at MSFC by approximately 20 Engineers across two groups. Future development will focus on the implementation of advanced algorithms.



Real-Time Vibration Monitoring System (RTVMS) & Advanced Health Monitoring System (AHMS)

- OSCorp personnel were instrumental in the development and integration of both NASA's RTVMS and AHMS systems.
 - » RTVMS is a DSP-based processing system that was developed in the mid '90s and is currently used at SSC for every SSME test to actively monitor real-time vibrations imparted by the rotating shaft of both high pressure turbopumps. The system can terminate an engine test within 150 milliseconds if an indication of a potential catastrophic hardware failure is detected.
 - » Due to the success of RTVMS, NASA began the evaluation of flight implementation of RTVMS algorithms in 1998. This led to the development of a tracking and sensor validation algorithm that subsequently initiated the SSME AHMS Controller Upgrade Program. Since the launch of STS-116 on December 9, 2006, all Space Shuttle Main Engines are equipped with AHMS Controllers.
- OSCorp is currently developing the Monitoring & Acquisition Real-time System (MARS) which is an enhancement of current RTVMS technologies that will incorporate RT Display™ and Plotypus™ tools into a hardware architecture utilizing a MATLAB enabled GPU.