



FRONTIER TECHNOLOGY, INC.

Advanced Technology
for
Superior Solutions.

TelemTrend™ Software Package

Abstract

An integrated sensor test, or more generally any test that collects time-ordered system health and status data over an extended duration, requires a managed approach to data storage and retrieval. Careful analysis of telemetry data (i.e. temperatures, pressures, voltages, currents, etc.) coming from the unit under test and/or its related test equipment is essential to predicting nominal behavior as well as understanding and rectifying anomalies or problematic trends. Frontier Technology, Inc. (FTI) has drawn on many years of experience in the field of space-based sensor calibration to develop the **TelemTrend™ Software Package**. The TelemTrend package is a database-enabled, C++-based application that allows the user to plot and analyze time-ordered telemetry data. Additionally, the TelemTrend package incorporates many proprietary algorithms that permit a deeper analysis and a richer understanding of features (spikes, trends, etc.) in the data. This product has a proven track record and continues to save our customers analysis time and program money.

Introduction

Historically, large science programs collect an enormous amount of corollary telemetry data. Apart from performance data, telemetry data types such as environmental conditions (component temperatures, chamber pressures, etc.), control parameters (command settings, alarms, etc.) and system measurables (impedance, power draw, etc.) are often stored as a matter of course. In the event that telemetry needs to be revisited however,



the method is usually a painful and time-consuming data mining process through countless separate log files culminated by manual collation in a generic program such as Excel® or MATLAB® software. This method is both inefficient and prone to mistakes. Additionally, applying filters or constraints in order to condition data for meaningful display is, again, a manual process and subject to the same disadvantages.

FTI has developed the TelemTrend package to address its customers' needs for robust telemetry data management and rapid display. It utilizes a MySQL® database server as a back-end mechanism to store up to thousands of separate telemetry streams collected at steady or varying rates and degrees of synchronicity. The front-end graphical user interface (GUI) is designed to take advantage of the database's structured query language to recall data. Any one or combination of the available telemetry streams can be displayed over a user-defined time window. The plot itself is fully interactive and supports zoom/pan. A comprehensive properties option gives the user access to numerous customizable features such as: labels, captions, toolbars, legends, color preferences and data/image output formats. The TelemTrend package has four tabs each dedicated to a specific analysis need. The available tabs are: Telemetry Trending, Auto-Trending, Spike Detection, and Drift Detection.

Telemetry Trending

The primary interface of the TelemTrend package is the Telemetry Trending tab shown in Figure 1. It consists of a plot control and a user interface for selecting data. A listing of the available telemetry items is read from the database and displayed on-screen. The user may then select up to ten separate telemetry items at a time to query from the database. Queries are constructed by selecting a time-window over which to plot data. Based on the user selections, the returned data is plotted on-screen versus time. The plot is interactive and supports mouse-driven zooming, axes control, and cursor events. Additionally, many tool options are available to the user for situational analysis. For example, alert and alarm level values are stored in the database and can be plotted over the on-screen data to study telemetry excursions. Fitting routines can be used to study slow trends in the data. A



separate plot of the operational setting (customized to the test) can be configured to plot on separate time-correlated axes as shown in Figure 1.

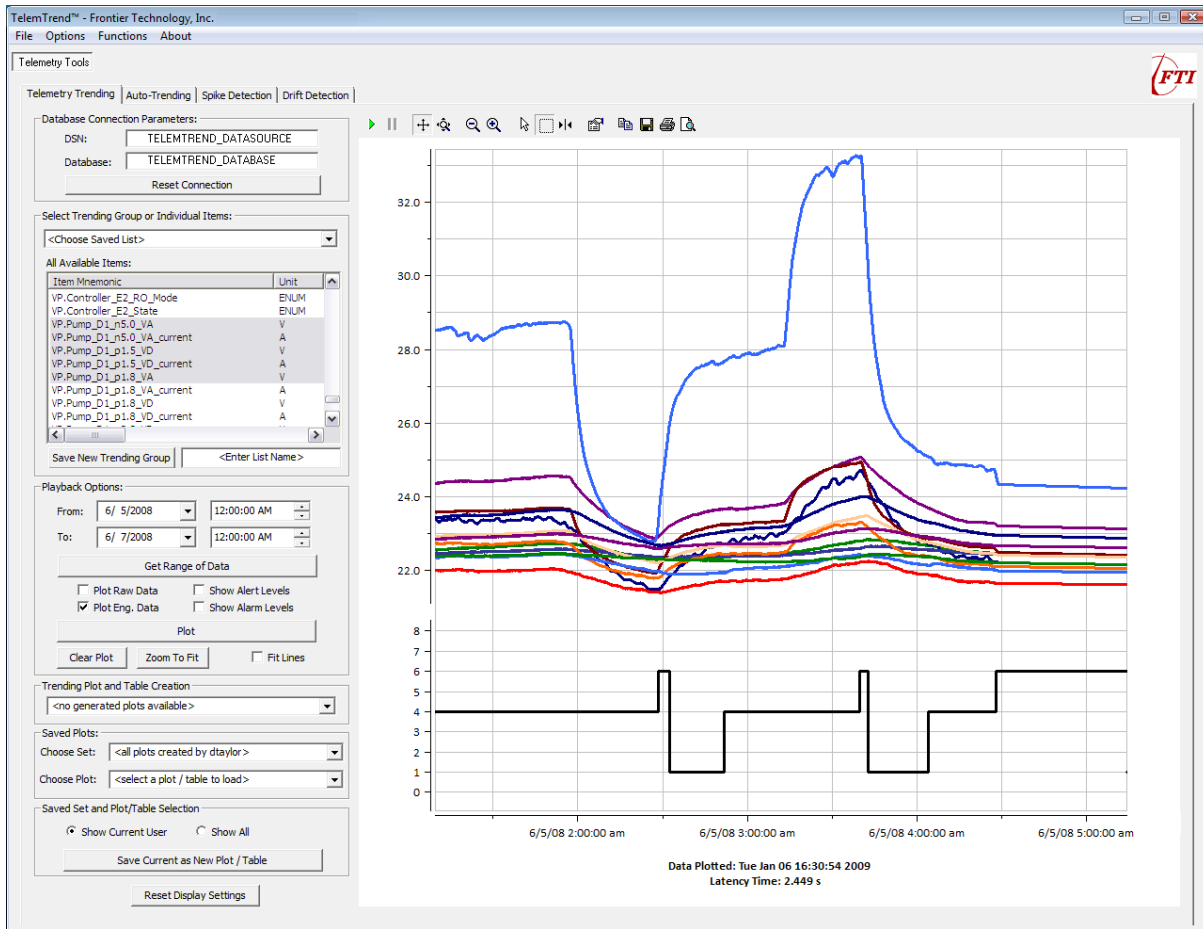


Figure 1: Telemetry Trending Tab Interface

Auto-Trending

The Auto-Trending tab contains much of the TelemTrend package's analysis product output options and is shown in Figure 2. It has been developed to reduce the time between active analysis and customer briefing. Pre-configured trending groups can be queued to automatically generate plots (in JPG or Microsoft PowerPoint® format) and summary tables. This capability offloads a significant portion of the work that goes into creating a presentation. Additional options can be selected to configure the presentation to highlight alerting or alarming conditions in the data to further streamline the process of assessing performance.

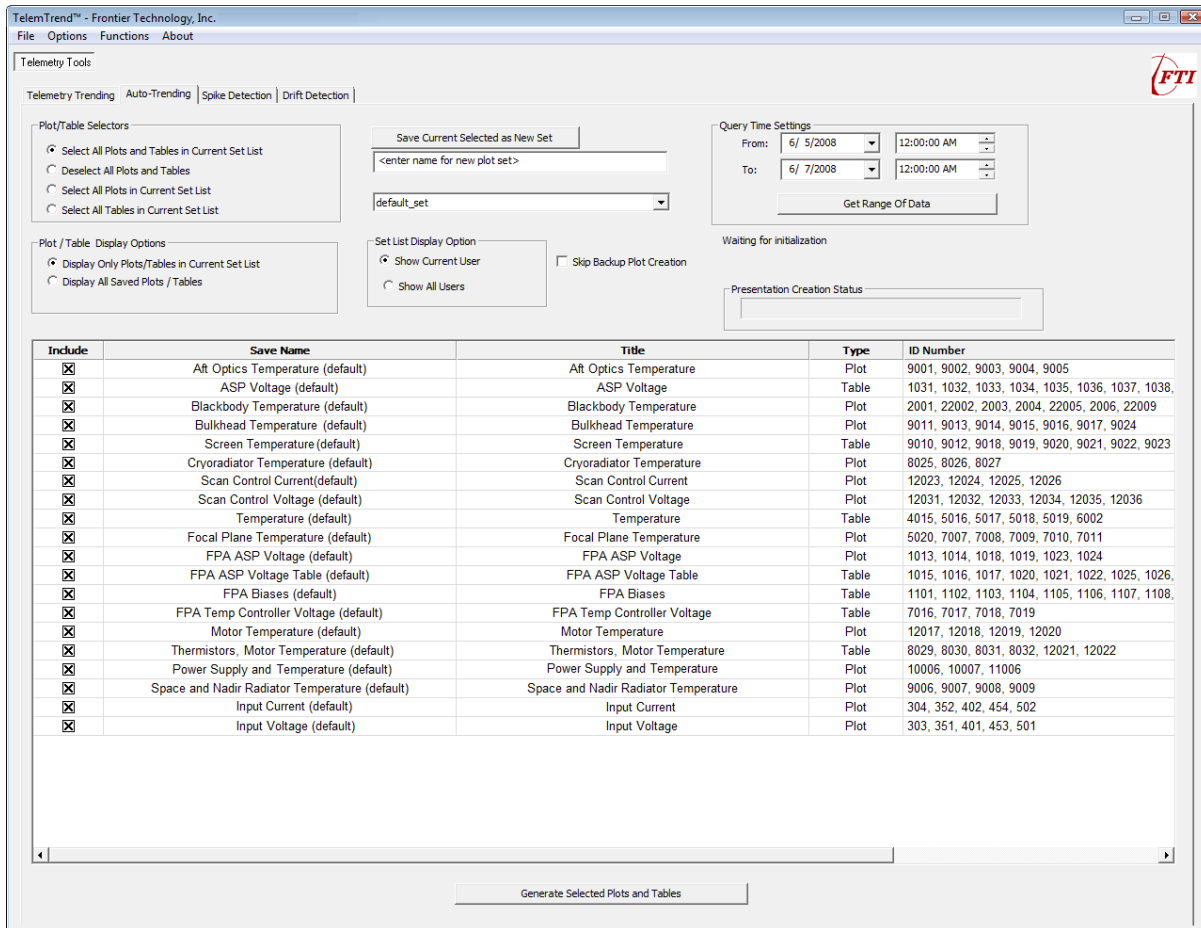


Figure 2: Auto-Trending Tab Interface

Spike Detection

The Spike Detection tab, shown in Figure 3, is used to detect and categorize so-called spikes in the data. A spike event is characterized as a measured value or set of values exceeding a user-defined threshold (simple value, multiple of σ/μ , etc.). This tab gives the user the capability to find these events, which may be indicative of problems in the test setup, and identify the cause. The operational mode can be plotted in conjunction with the spike event(s) to identify control transients or unplanned excursions. Additionally, this tab includes a categorization element that identifies the spike event type based on user-defined parameters (i.e. a transition start or spike event lasting more than 1 minute, etc.). As with the other tabs, access to pre-defined telemetry groups and the full array of export options make this an invaluable analysis tool.

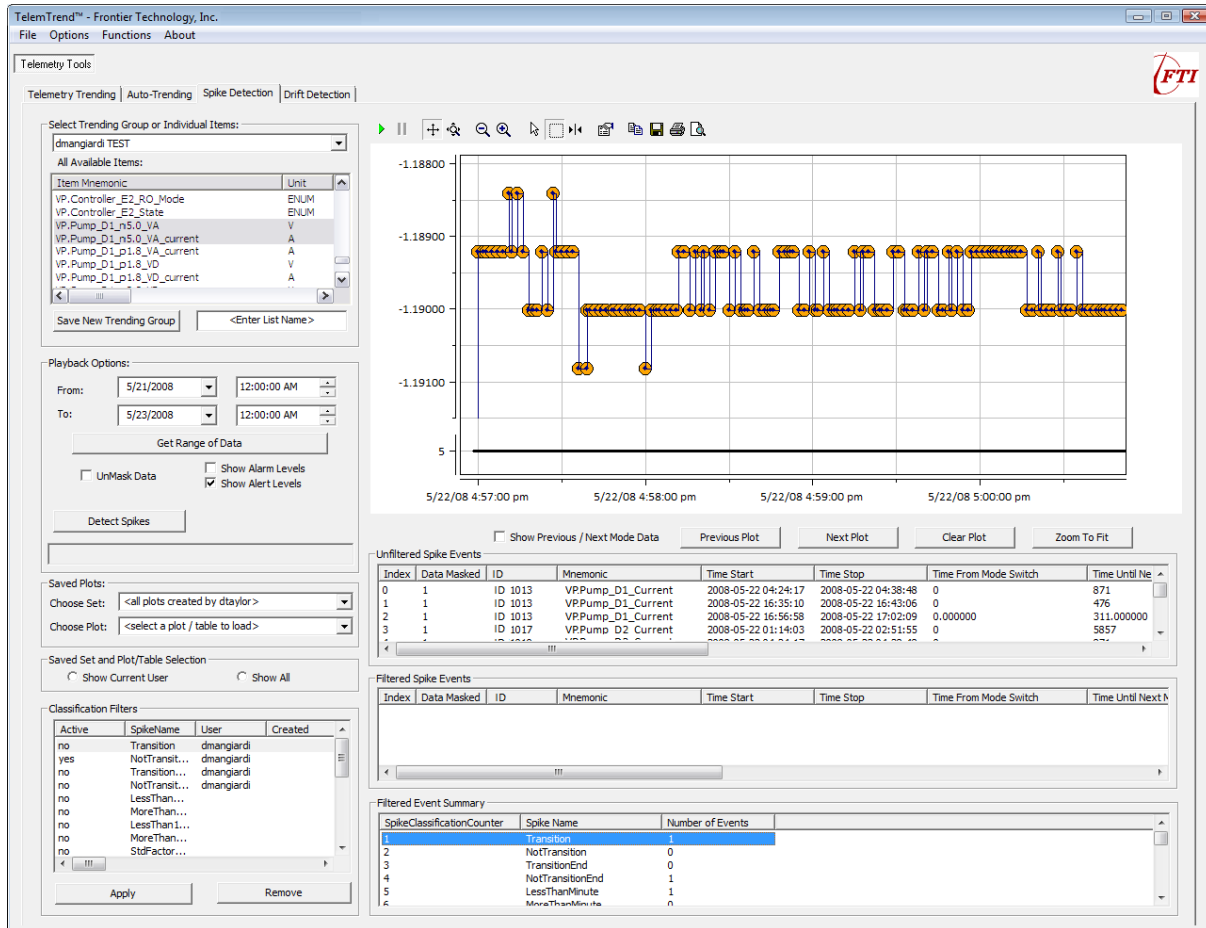


Figure 3: Spike Detection Tab Interface

Drift Detection

The Drift Detection tab, as shown in Figure 4, automatically detects and categorizes drifts (slow trends) in the data. Drift is defined as a calculated value exceeding the user-defined threshold $\Delta X/\Delta t$, where X is the data value at a particular time t. Similar to the Spike Detection tab, the Drift Detection tab gives the user the capability to automatically mine the data for drift features that may be indicative of larger issues in the test setup. This tab includes the standard plot control and export options.

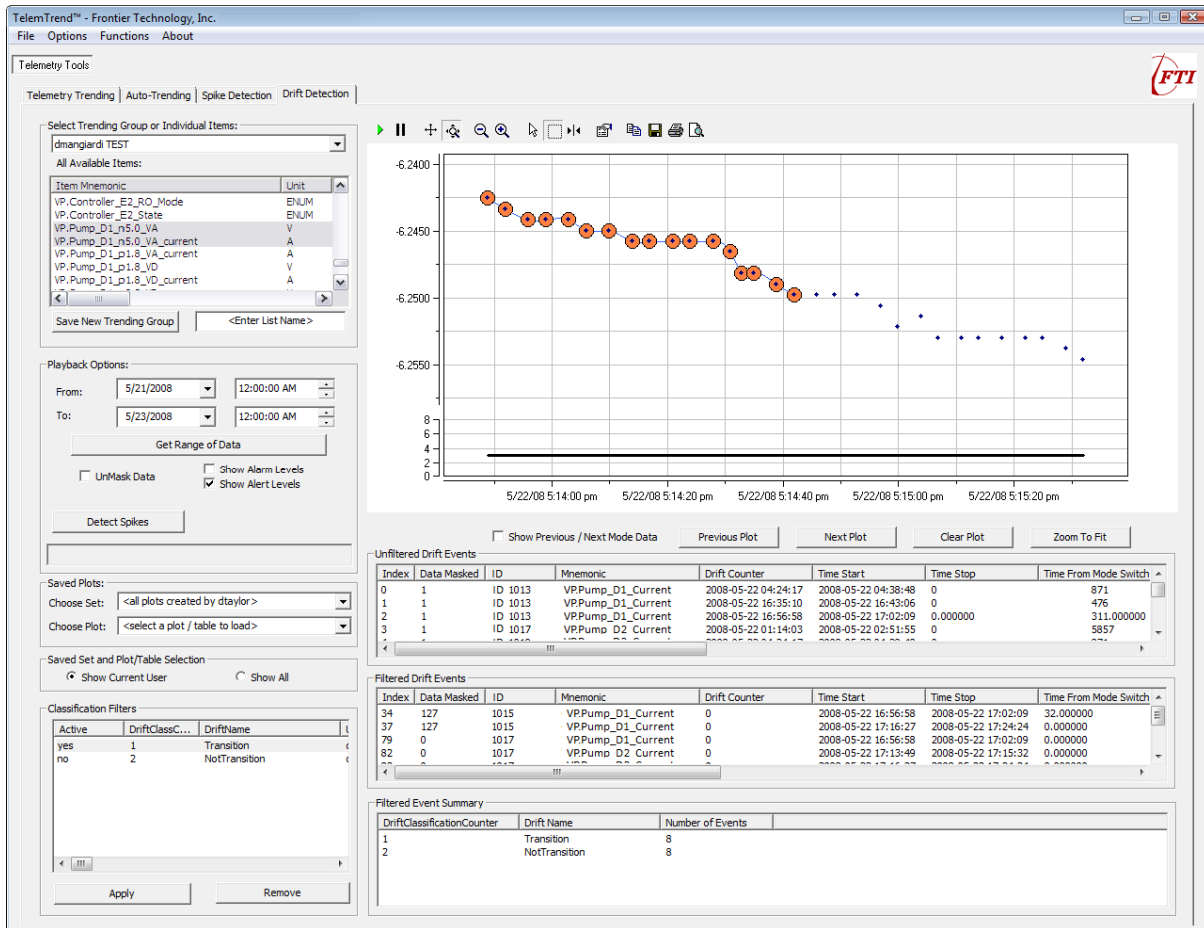


Figure 4: Drift Detection Tab Interface

TelemTrend™ Server

The spike and drift detection features of the TelemTrend software package operate on telemetry data that has been retrieved from the database. The database retrieval and the detection algorithms can be very time-intensive if large quantities of data are being surveyed. To significantly improve performance, FTI has developed an associated product: TelemTrend™ Server. TelemTrend Server performs time-intensive calculations in the background in an automated fashion. Processing capabilities include segmentation of telemetry data by operating mode, detection of drift and spikes, and generation of statistics. If TelemTrend Server is running, then the TelemTrend software simply retrieves the final calculations from the database instead of performing the calculations. A single instance of

TelemTrend™ Software Package

TelemTrend Server running on the database server can significantly improve analyst efficiency by drastically reducing the amount of time they must wait for these types of monitoring information. Please contact FTI for more information about TelemTrend Server.

Customization

The TelemTrend software package has been developed using a module-based approach to coding. As such, it is highly customizable. FTI has a long history of working with its customers to tailor software analysis packages to specific requirements. Examples of prior customizations include real-time display, test management features, additional tabs in the software for test-specific calculations or display features, and prognostic health monitoring. FTI also offers customized tools to assist with getting customer telemetry into the database via upload or transfer. These tools may range from database stored procedures to stand-alone applications to TelemTrend Server add-ons. Experience has shown that units under test often have unique data sets and formats that require the data migration solution to be specifically tailored. Please contact FTI for additional information about our data interface and migration tools.

Conclusions

FTI is committed to formulating efficient and cost-effective solutions to customer data management and data visualization issues. The TelemTrend software package is a configuration management and data analysis product that has previously been implemented, validated, and appreciated by our customers. The TelemTrend package has been instrumental in saving our customers' time and money during testing and analysis on many of their data-intensive programs. We look forward to working with you to make your program a success!



About FTI

Frontier Technology, Inc. is a small business that was founded in 1985. There are three groups within FTI: Decision Support Products and Services, Sensor Data Products and Services, and FTI Services. FTI's Phenomenology Operation within the Sensor Data Products and Services Group has unique expertise in sensor system analysis and performance evaluation, experiment development, and program planning, especially in the areas of sensor data certification, sensor systems calibration, sensor data management, optical remote sensing, and natural background phenomenology. For more information about FTI, please visit our website at www.fti-net.com or email us at phenomtools@fti-net.com.

Excel and PowerPoint are registered trademarks of Microsoft Corporation, MATLAB is a registered trademark of The MathWorks, Inc., and MySQL is a registered trademark of MySQL AB.

