

# Introduction to FAST Data Analysis

## Introduction

FAST data analysis software was designed in the mid-1990s around two programs: SDT and IDL. SDT and its support programs provided a real-time GSE during I&T and the FAST campaign. SDT also provides fast data accesses and display during data analysis. An IDL hook was developed to provide a platform that allowed scientists to access the data directly and build their own data analysis tools without having to interact with the SDT software developers.

## SDT Overview

SDT is an in-house C-compiled program with a wiglit-interface that can read level-0 files, display line plots and spectrogram plots, and perform science analysis (FFTs, correlations, etc) on selected data. SDT is freely available for download from the SSL-FAST web site.

SDT operates under Unix or Linux and can access data from the FAST, Polar, Cluster, Geotail, THEMIS, ISEE, and CRRES missions. For FAST data analysis, SDT generally relies on the “Data Manager” program to access level-0 files locally or remotely. Documentation on SDT can be found at:

<http://sprg.ssl.berkeley.edu/fast/scienceops/docs>

A tar file of the complete software package (including IDL routines) can be found at:

<http://sprg.ssl.berkeley.edu/fast/scienceops/fastidl.html>

## IDL Overview

IDL is a commercial program with a vast array of programming and display tools that allow the scientist to perform an in depth analysis of FAST data independent of SDT. IDL can be used in conjunction with SDT or can be used separately on CDF files downloaded from the FAST web site. FAST summary CDF files can be found at:

<http://sprg.ssl.berkeley.edu/htbin/fastcgi/sumplotsNetscape/recentplot.pl>

FAST high resolution CDF files can be found at:

<http://sprg.ssl.berkeley.edu/fast/hires/>

The long term archive plan will develop a complete set of high resolution CDFs and IDL software that allow complete access to all FAST data independent of SDT.

FAST IDL software builds on software developed for the WIND mission. It includes many tools for displaying data (time series, line plots, spectrograms) and analyzing data. Most programs for reading data into IDL assume the data of interest is already loaded into SDT. Standard naming conventions and functionality were adopted in the mid-90s, however this diverged over time from WIND software. There is an effort underway to bring FAST, WIND, and THEMIS data analysis back in line, with common tools that operate under all platforms supported by IDL.

FAST IDL software is command line driven. However the experienced user rarely types many commands. Instead the user will develop a command crib – a text file that lists typical commands and combinations of commands that perform repetitive tasks. As command cribs are refined, they are often turned into programs. Command cribs can also be used to keep a record of a command set that will generate a specific plot.

A typical FAST data analysis recipe:

***To run SDT ...***

1. Initialize environment variables for SDT with a setup script.
2. Start SDT in a unix window and an SDT window will pop up.
3. In the SDT window
  - a. Select “ADD WINDOW” and a plot window will pop up.
  - b. Or Select “CONFIG” and use an existing plot template for your plot window.
4. In the plot window
  - a. Right click - Select “ADD PLOT” to add data quantities to a plot window
  - b. Right click within each plot to get a separate “plot specific” menu
  - c. Right click borders of the plot window to display global plot menu
  - d. Right click “Data Manager” on global plot menu to get data manager window
5. In the Data Manager window
  - a. Enter an orbit, orbits, or time range.
  - b. Click the “Submit query” button (data request)
  - c. Click “Return to SDT” to download and display data in the plot window

### ***To run IDL ...***

1. Initialize any IDL environment variables with a setup script
2. Start IDL in a unix window
3. Open a new or existing “crib” file in a text editor.
4. Type or edit IDL commands in the crib file.
5. Copy and paste commands from the crib to the IDL command line.

FAST IDL data is stored in data structures within IDL. There are two general types of data structures used: “tplot data structures” and “main data structures”. “tplot data structures” are stored in a “tplot” common and are not visible directly from the main command line. They can be viewed with the “tplot\_names” command. “main data structures” are visible from the main command line with a “help” command.

Data are extracted from SDT memory into IDL data structures with commands that begin with “get\_” or “load\_”. “load\_” commands are generally programs that load data into “tplot structures” whereas “get\_” commands are generally functions that return a data structure to the IDL “main”. Tplot structures are plotted with the “tplot” command followed by a list of tplot structure names or numbers. For example:

```
tplot,[1,2,3,7]
```

would plot the first three and seventh tplot structure. There are also several tools to access these tplot structures directly (see `get_data`, `store_data`, etc.).

There are also numerous functions for plotting “main data structures”. For example, plasma data from the ESAs can be extracted from SDT into “main” with the following pair of commands:

```
t=string_to_time('2001-09-11/6:00') & esa_dat = get_fa_ees(t)
```

The ESA spectra can then be plotted with:

```
spec2d,esa_dat
```