SPEDAS Tutorial

GEM 2018, Santa Fe, NM
Agenda

SPEDAS Tutorial

Opening remarks

SPEDAS development status

New features, plugin status updates

Live demo: HAPI, Autoplot, GUI plot templates

Q&A, discussion
What is SPEDAS?

Space Physics Environment Data Analysis Software (SPEDAS)

- Grass-roots data analysis software for Space Physics Community
- SPEDAS is an outgrowth of THEMIS / ARTEMIS code that has been extended to support multiple missions
- Standardizes retrieval of data from distributed repositories
- Science processing and graphics contain powerful set of legacy routines.
- The THEMIS mission is now served through the TDAS plugin

The SPEDAS framework:

- Contains a GUI for ease of use (available through IDL VM freeware)
- Command line provides full access to IDL (paid license only)
- Works with Windows, Linux and Mac OS X.
- Is based on IDL, benefiting from platform independence and software maintenance services.
What is the current status of SPEDAS development?

SPEDAS 3.0 was released in April, 2018, and includes these recently added features:

- New plugin for Spherical Elementary Currents System (SECS) allows loading of EICS (Equivalent Ionospheric Currents) and SECA (SEC amplitudes) data, as well as plotting over THEMIS ASI mosaic maps.
- New plugin for DSCOVR mission, including data loading, overview plots, and line plots with shaded confidence intervals.
- Updates to ERG, IUGONET, THEMIS, and MMS plugins
- Improved HTTPS support for digest authentication, and significant performance improvements when creating large numbers of new TPLOT variables.
- Support for downloading data via the Heliophysics Application Program Interface (HAPI)
- Preliminary support for exporting data from SPEDAS to Autoplot
- Support for saving tplot variables as ISTP-compliant CDFs (tplot2cdf)
ERG (Arase) Project

Mariko Teramoto
DSCOVR confidence interval plot, from projects/dscovr/examples/dsc_crib.pro:

tplot,
['dsc_h1_fc_Np','dsc_h1_fc_THERMAL_TEMP','dsc_h1_fc_THERMAL_SPD','dsc_h1_fc_V_GSE_x'] ;aka [25,26,24,27]
dsc_dyplot
DSCOVR overview plot (dsc_crib.pro)

```
trg = timerange(['2017-02-18/03:00:00','2017-02-18/15:00:00'])
dsc_overview,trange=trg ; Overview for a given timerange
dsc_overview_mag,trange=trg ; Overview of Magnetometer data
dsc_overview_fc,trange=trg ; Overview of Faraday Cup data
```

![DSCOVR Overview Plot](image)

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Santa Fe, NM -- June 2018
SECS ASI Mosaic plot (projects/secs/examples/secs_mosaic_plot_crib)
Voyager 1 proton flux via Heliophysics API (HAPI), from idl/general/crib_hapi.pro:
Cassini mag data via Heliophysics API (HAPI), from idl/general/crib_hapi.pro:
ISEE 3D settings panel (using THEMIS data)
ISEE 3D: MMS FPI ion scatter plot

2015-10-20/05:56:35.957 : velocity
ISEE 3D: MMS FPI ion volume plot

2015-10-20/05:56:35.957 : velocity
ISEE 3D: MMS FPI ion contours

2015-08-15/12:50:03.923 - 12:50:57.923 (velocity)
To Load CDAWeb Data:
- Select ‘Load Data using CDAWeb’ under the File menu
- Select Mission Group (i.e., TWINS, Cluster, RBSP, etc.)
- Select the Instrument Type
- Click ‘Find Datasets’
- Select variable or dataset to download
- Click ‘Get CDAWeb Data’
THEMIS and RBSP Plots

- With a few clicks of the button the user can load, analyze, and plot data.
- Interactive Capabilities
SPEDAS Mini Language

- Simple scripting language has been written in IDL.
- This language allows access to some data analysis functionality in the IDL virtual machine and eases manipulations of time series (tplot) data.
- This language allows composition of statements and functions with order of operations to give significant flexibility in statement construction.

Examples:

1: Position to RE:
   \[
   \text{calc,}'\text{tha\_pos\_re}' = '\text{tha\_state\_pos}'/6374.4
   \]

2: Natural log of total esa density:
   \[
   \text{calc,}'\text{tha\_density\_log}'
   = \ln('\text{tha\_peir\_density'}+'\text{tha\_psif\_density}''\])
   \]

3: Average magnetic pressure:
   \[
   \text{calc,}'\text{Pb\_avg}' = \text{mean}(0.01*\text{total}'\text{tha\_fgs\_dsl}''^2,2)/25.132741)
   \]

Additional examples can be found in general/examples/crib_calc.pro
Data Analysis

Available Data

Active Data

Common Functions

Data Processing

Loaded Data

Active Data

- Subtract Average
- Subtract Median
- Smooth Data
- High Pass Filter
- Block Average
- Clip
- Delflag
- Degap
- Interpolate
- Clean Spikes
- Time Derivative
- Wavelet Transform
- Power Spectrum
- Coordinate Transform
- Split Variable
- Join Variables

(2014-12-12/07:24:48) 10: Bad Selection, Please try again
Magnetic Field Models

The GUI is now able to:
- Model the field at the spacecraft position
- Trace field from position to the ionosphere and equator
Load Data panel (MMS plugin tab)
Configuration settings panel (THEMIS plugin tab)

<table>
<thead>
<tr>
<th>SPEDAS</th>
<th>BARREL</th>
<th>G0ES</th>
<th>Geomagnetic Indices</th>
<th>MAVEN_PFP</th>
<th>OMNI</th>
<th>POES</th>
<th>THEMIS</th>
<th>WIND</th>
</tr>
</thead>
</table>

Local data directory: `c:/data/themis/`

Remote data directory: `http://themis.ssl.berkeley.edu/data/themis/`

Download Data:  
- [ ] Automatically
- [ ] Use Local Data Only

Update Files:  
- [ ] Update if Newer
- [ ] Use Local Data Only

Load into GUI:  
- [ ] Load data
- [ ] Download Files

Verbose (higher value = more comments): 2

![Configuration Settings Panel](image)

Save To File  
Cancel  
Reset to Default

Status information is displayed here.

0: Status information is displayed here.
• **SPEDAS Development Roadmap**

  • SPEDAS 3.00 was released in April 2018; SPEDAS 3.1 expected in July 2018.

  • SPEDAS 3.1 will include support for the TS07D field model implemented in the latest update to the GEOPACK library, a plugin for ICON, and a GUI interface for performing Minimum Variance Analysis.

  • Our QA procedures, release schedule, and set of deliverables need a bit more flexibility to keep up with new plugins as they are released or updated.

  • In future releases, we hope to expand the scope of some mission-specific tools (for example, particle moments, 2-D and 3-D visualization tools, spectrograms, pitch angle distributions) to more generic solutions that can be applied to multiple missions.

  • We continue to work closely with other projects, to support integrating their software tools into SPEDAS as plugins or core capabilities.

  • SPEDAS in Python: Efforts are underway to coordinate with other developers working on heliophysics packages in Python, with the goal of porting SPEDAS tools to Python
• SPEDAS Development Roadmap

  • Currently, all crash reports and help requests are routed to the THEMIS science support address, even if the crash or problem occurs in some other plugin. Future releases should allow each plugin to define its own error handlers and reporting policy.

  • We have conducted several WebEx tutorial sessions covering various capabilities of the SPEDAS software and plugins. These sessions allow us to go into far greater detail into the nuts and bolts of using SPEDAS for realistic data processing tasks.

  • We will be looking into implementing more tools to support exporting data as CDFs with standard metadata (ISTP, SPASE).
Spedas.org is now live!

SPEDAS and plugin downloads

Documentation wiki

Mailing list

Blog

Google group (https://groups.google.com/forum/#!forum/spedas)

We welcome plugin developers to contribute content and participate in discussions on the SPEDAS site! (Registration required for wiki and blog edit privileges; please contact Jim Lewis (jwl@ssl.Berkeley.edu) to gain access).
Introduction:
- You Tube Channel
- SPEDAS video
- Introductory Examples
- Screen shots
SPEDAS Downloads

Select:
1.2 Downloads
From Main Page

spedas.org/wiki/index.php?title=Downloads
Analyzing MMS data with SPEDAS

MMS Plug-in Tutorial Tomorrow, 1:30PM!

Anasazi Ballroom

email me: egrimes@igpp.ucla.edu