

THEMIS SOC Software Developers' Guide

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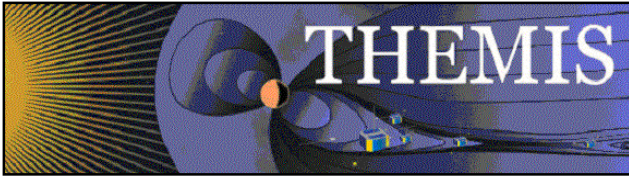
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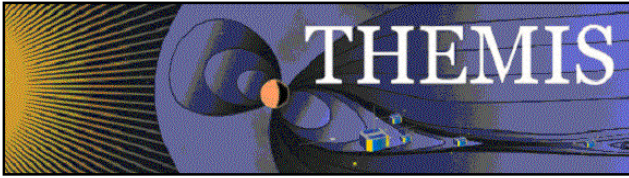


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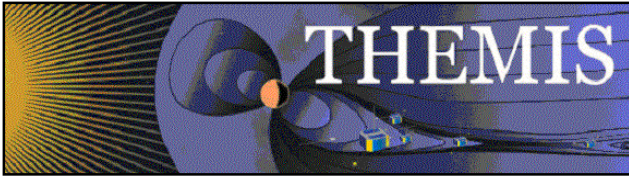
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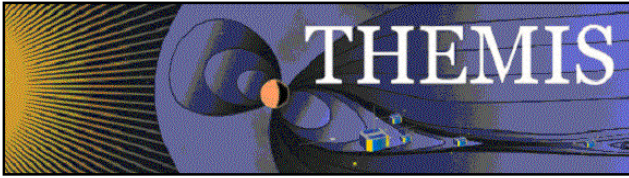
1. Introduction

1.1 Purpose and Scope.

The THEMIS SOC taps into a legacy of software used for science operations for existing missions such as Cluster, Wind, Polar and FAST. Thus the THEMIS SOC is designed primarily to facilitate building the THEMIS system using components from the other missions, and leaves a place for past and future missions to be alongside the THEMIS software in an integrated SOC software system. In particular, the IDL software used on WIND, FAST, etc. is being re-organized by the THEMIS software developers and scientists, and checked into a software management database—using the freeware Subversion (SVN)—for maintenance, tracking updates and contributions by a distributed team, and ensuring self-compatibility. In addition to the IDL software that is used by the THEMIS science community at large, the SOC includes software for production processing of L0 to L1, L1 to L2, summary data and summary plots, web sites, etc. This document describes the layout of the repository, the procedures for adding new software to the repository, and procedures for maintaining that software in the repository. This document also explains the relationship between the repository structure, on the one hand, and released software and SOC production workspaces, on the other, including the procedures for building workspaces, creating code snapshots and distributing software releases.

1.2 Applicable Documents.

- | | |
|---|---|
| 1. THM_SYS_012_PDMP | THEMIS Project Data Management Plan |
| 2. THM_SOC_101_TIME | THEMIS TIME Definition |
| 3. THM_SOC_108_GMAG_L1_VARNAAMES | THEMIS GMAG Variable Name Def's |
| 4. THM_SOC_111_SUNSENSPROC | THEMIS SUN SENSOR Science Processing |
| 5. THM_SOC_112_ATTPAIPROC | THEMIS Science ATT & Inertia Determ. |
| 6. THM_SOC_113_FGM_CALPROC | THEMIS FGM CAL File and Processing |
| 7. THM_SOC_114_SCM_CALPROC | THEMIS SCM CAL File and Processing |
| 8. THM_SOC_115_EFI_CALPROC | THEMIS EFI CAL File and Processing |
| 9. THM_SOC_116_ESA_CALPROC | THEMIS ESA CAL File and Processing |
| 10. THM_SOC_117_SST_CALPROC | THEMIS SST CAL File and Processing |
| 11. SAI-SPEC-1079A (Oct 26, 2005) | THEMIS Coordinate systems |
| 12. SAI-RPT-0722a (September, 2006) | Probe Alignment Report (MSSS data, p18) |
| 13. pturin e-mail on Faro alignment results (9/28/06) | FGM, SCM mag alignments |
| 14. THM-MB-MEC-005-Magnetometer clocking r7.pdf | MAG clocking angles |



2. Design of the THEMIS SOC software system

The THEMIS SOC software consists of several distinct, but interconnected components:

1. THEMIS SOC software
 - a. THEMIS production software
 - b. THEMIS Science IDL software
 - i. The programs are IDL-based. They are used to open, analyze and plot L1 or L2 data, process L1 data into L2 files, and also translate data into other products (e.g., ascii) as necessary.
2. space physics IDL software
 - a. tplot
 - b. file access
 - c. misc
3. externally developed IDL software ‘vendor drops’
 - a. CDAWlib
 - b. SSW (SolarSoft)

In addition, there is a toolchain of open-source and proprietary software used for building and maintaining the system.

Each of the above components has a corresponding place in the repository:

1. \$\$SOCREPOS/thmsoc
2. \$\$SOCREPOS/ssl_general
3. \$\$SOCREPOS/idl_external
 - a. \$\$SOCREPOS/idl_external/CDAWlib
 - b. \$\$SOCREPOS/idl_external/ssw_gen_idl

These components are combined to create working software systems, each of which has its own place in the repository:

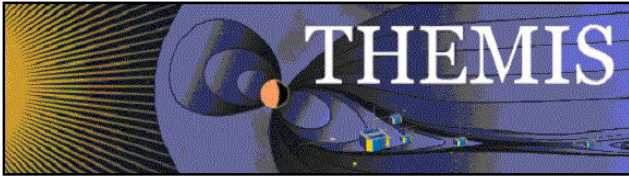
\$\$SOCREPOS/thmsw	released THEMIS Data Analysis Software (TBD-currently idl_socware is used to build thmsw, because software specific to other missions has not yet been added to the system)
\$\$SOCREPOS/idl_socware	A lab-wide, multi-mission IDL software repository (of which the THEMIS Data Analysis Software is conceptually a subset). Resides at /disks/socware/idl
\$\$SOCREPOS/thmsoc	THEMIS SOC production workspaces.

Each system is built up by including other components in the SVN repository by using one of the following SVN version control methods: ‘svn copy’ or the svn:externals property.

The ‘svn copy’ method is used when local modifications will be made to the sub-system, while the original sub-system itself must be isolated from those changes (at least temporarily).

The ‘svn:externals’ property method is appropriate in two distinct circumstances:

1. when the component will be used as-is, the externals property should refer to a specific version (i.e. tag), preferably with an explicit version number.
2. when the component should be treated as an integral part: changes made to the component withing the system also affect the component itself. Ie, the externals property



refers to the head of the ‘trunk’ of that component. Note that this is dangerous if another system also depends on that component: both systems will have to be maintained simultaneously.

2.1 Naming Conventions

Routines operate on (as input and/or output) both arrays and tplot variables (i.e. handles to structures which contain data as well as information about how to display that data in time plots), with an option to do either one (or both).

The naming convention is that all THEMIS-specific routines begin with `thm_` followed by the function (action) followed by the type of data operated upon. E.g., `thm_load_xxx` reads `xxx` data.

Routines are as general and encompassing as possible; they rely on keywords (or data file name) for branching out to specific functionality.

Some examples of routines which follow the THEMIS naming convention:

<code>thm_load_esa</code>	loads esa data
<code>thm_cal_mom</code>	calibrates all (ESA and SST) moment data from L1 data to physical quantities.
<code>thm_pa_sst</code>	Combines SST psd, and FGM and provides pitch angles dist.
<code>thm_cotrans</code>	Coordinate transformation from any to any Earth centered, in particular from GSE to other. It uses the THEMIS-specific STATE file as an input, but is not specifically for transformation of any on type of THEMIS data.
<code>thm_crib_ask</code>	Crib sheet for loading and displaying All Sky Keogram data.

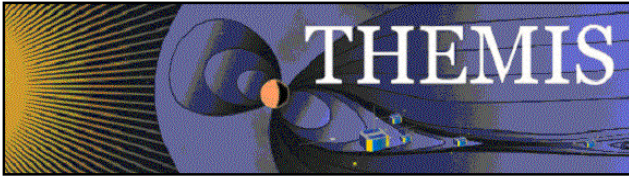
2.2 Self-Documentation Conventions

Each file should include comments for self documentation. In IDL, an example would be as follows:

```

;+
;THM_LOAD_GMAG
;
;Procedure: THM_LOAD_GMAG,station
;
;keywords:
; TRANGE= (Optional) Time range of interest (2 element array).
; /VERBOSE : set to output some useful info
; /SUBTRACT_AVERAGE ;
;Example:
; thg_load_mag,'bmls'
;Notes:
; This routine is (should be) platform independent.
;
; $LastChangedBy$
; $LastChangedDate$
; $LastChangedRevision$
; $URL$
;-

```



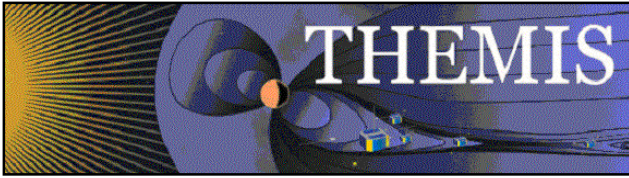
2.3 Software Organization

2.3.1 THEMIS Data Analysis Software

The structure of the THEMIS Data Analysis software is as follows:

The themis directory is for THEMIS-specific routines. The general directory (currently named ssl_general) is for routines which are useful for more than one space-science mission for which THEMIS team members are developing code. The external directory is for packages developed and maintained by other groups, but which are required for writing (and running) the themis and/or general routines. The distinction between general and external can be blurry...

The THEMIS SOFTWARE distribution is a snapshot of /disks/socware/idl (or perhaps a subset of this, if other instruments are added in the future). The idl directory of the distribution includes the following files and sub-directories.



thmsw_doc.html	Documentation in HTML format, including alphabetical list of all routines.		
themis/	setup_themis	Sample setup script for csh (UNIX)	
	ground/	routines for loading, processing and plotting ground-based data. e.g. thm_load_gmag, thm_gmag_stackplot, imageplot, mosaicplot	
	spacecraft/	fields/	routines for loading, processing and plotting particles data, e.g. thm_proc_fgm
		particles/	(Should be particles/) routines for loading, processing and plotting particles data, e.g. thm_load_sst, thm_cal_sst, thm_pa_sst
	orbit/	Routines for reading state and performing coordinate transformations, e.g. thm_load_state, thm_despin, thm_ssl2spg, thm_dsl2gse, thm_cotrans	
	examples/	Crib sheets, like thm_crib_ask	
common/	Themis-specific tools useful to multiple data types and instruments, eg themis_w (The THEMIS GUI)		
ssl_general/	CDF/	CDF utilities, including cdf2tplot, and perhaps other utilites like cdf2flat, cdf2ascii, cdf_load (into IDL arrays)	
[should be general/ ?]	analysis/		
	cotrans/	Incorporate ROCOTLIB here, or keep it as external?	
	tplot/	General time-plotting utilites	
	misc/	Miscellaneous routines used by tplot and other ssl_general routines.	
	orbitplot/	General orbit-plotting utility.	
external/	SSW_gen_idl	direct import of a portion of SSW general IDL routines	
	ROCOTLIB	direct import of rocotlib – thm_cotrans, etc are wrappers around this.	
	CDAWeb		
	Radars		
	facility 1		
	QSAS		

2.4 Availability of Code and Documentation.

Zipped and tested code releases along with corresponding documentation are available in release folders which can be found at the following URL:

<http://themis.ssl.berkeley.edu/socware>

For example, the latest release as of the writing of this document (December 20, 2006) is in:

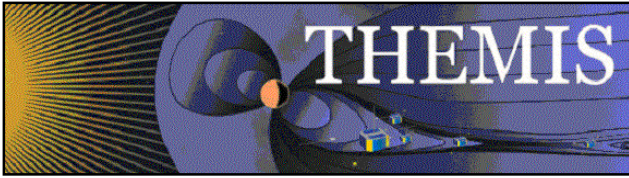
http://themis.ssl.berkeley.edu/themisdata/socware/thmsw_0_3b_20061220/

Each release folder contains

- idl folder for browsing the source and documentation.
- zip file for download of entire contents of the idl folder.
- doc folder containing the version of this document corresponding to the released software.

The zip file includes IDL files and HTML documentation. HTML-browsable documentation of the IDL routines is available within each release folder at idl/thmsw_doc.html.

The latest THEMIS code being developed and/or integrated at the THEMIS SOC is visible at http://themis.ssl.berkeley.edu/themisdata/socware/bleeding_edge. The idl subdirectory of bleeding_edge is a link to /disks/socware/idl, which is the integration/testing area for the latest data analysis software at UCB SSL. There is no guarantee that the software and/or HTML documentation available for browsing is the



most up-to-date version available at any given time. The `/disks/socware/idl` workspace can be made up-to-date and a snapshot can be created on demand, to allow access to the latest THEMIS software. The software included in these snapshots is made available without warranty or guarantee. The snapshots will be available as zip files within the `bleeding_edge` folder. Each snapshot zip file contains the complete set of IDL source files and corresponding automatically generated HTML documentation. The snapshot file name corresponds to the SVN revision number and date of the last change that was committed to the THEMIS SVN repository at the time the snapshot was made.

Even more up-to-date and detailed access to the THEMIS code will be available through a web interface to the SVN repository (read-only) `http://` or `svn://` URL to be determined. This is for access to the very latest version of the code, plus possibly access to the SVN change log.

2.5 SVN Administration issues

Adding a new user

Give access to `thmsw`.

This allows them to update `/disks/socware/idl`, create snapshots, cut deliveries, and get access to `thuser` account for testing. It also gives them access to `thmsvn` account for SVN administration.

```
ssh thmsw@ambrosia
add their public key to .ssh/authorized_keys
```

Give access to svn repository

```
# log in as thmsvn (use the following alais command to do so from the thmsw account)
```

```
thmsvn
add their public key to .ssh/authorized keys
```

Follow the pattern of existing entries, being sure to update the `-tunnel-user` with the user name of the new user. Detailed instructions are included in the comments of the `.ssh/authorized keys` file.

2.6 Repository layout

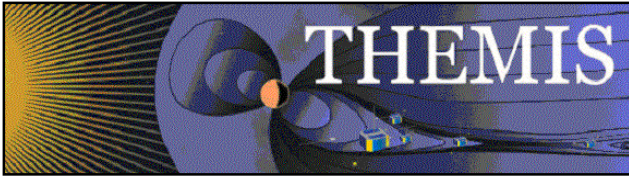
`/disks/socware/toolchain/current/setup` defines the following variable:

```
$SOCREPOS
```

```
$SOCREPOS points to the SPRG SOC repository
svn+ssh://thmsvn@ambrosia.ssl.berkeley.edu/repos
```

The repository physically lives at `/disks/socware/thmsvn/repos`, and can only be administered/accessed from the `thmsvn` account.

The repository contains multiple Projects. Each project usually consists of a trunk, which contains the main development, tags for marking releases and branches for development/testing which needs to be isolated from the trunk. For example, a developer can make a personal branch. Changes can be committed to the personal branch without disturbing the integrity of the trunk. Changes made to the branch may be merged into the trunk when the developer is ready to share with others.



idl_external	location for 'vendor drops'	
idl_socware	trunk, branches, tags external	properties on external point to numbered versions of external 'vendor drops' in idl_external, or you can use 'svn copy' to copy a version in. The latter case is useful if you plan to modify the code.
ssl_general	trunk, branches, tags	
thmsoc	trunk, branches, tags	

2.7 Updating a vendor drop

Vendor drops are an exception to the rule of using trunk, branches, and tags. Instead, a vendor drop folder in the repository only contains tags. Thus a vendor drop into the idl_external folder is appropriate when no internal development will be performed on a library, and the intent is only to track external changes and versions.

Example 1: CDAWlib

CDAWlib 3.0b becomes available to replace previously used version (version unknown, so we used 1.0)

Plan: update

idl_external/CDAWlib/current to contain CDAWlib 3.0b. Tag it as 3.0b

Unpack CDAWlib.tar.gz into a directory, CDAWlib-3.0b

Update the 'current' tag of CDAWlib in the repository to contain CDAWlib 3.0b, and tag it as 3.0b.

```
svn_load_dirs.pl -t 3.0b \
  $SOCREPOS/idl_external/CDAWlib \
  current \
  CDAWlib-3.0b
```

The svn_load_dirs.pl script finishes by diffing a temporary version of your tag with the original version you are importing. There may be differences if the version you are importing includes keywords. Just live with it, or turn off the keyword substitution property.

Example 2: ssw/gen/idl

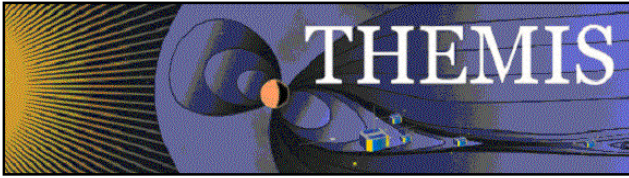
The ssw/gen/idl sub-tree of the SolarSoftWare (SSW) library is included in the SOC repository.

/disks/solar/home/ssw/gen/idl is updated automatically daily. So to synchronize the current version and tag the version at a given day:

```
svn_load_dirs.pl -t 2007-01-25 $SOCREPOS/idl_external/ssw_gen_idl current \
  /disks/solar/home/ssw/gen/idl
```

If files have been renamed or moved, you will be prompted to direct svn_load_dirs to copy an old name to a new name:

```
Deleted                               Added
  0 display/arr2gif.pro _____ mapping/align_map.pro
```



```
1 util/delvarx2.pro _____ image/arr2gif.pro
2 util/eci2geographic.pro _____ solar/eci2geographic.pro
3 util/edge_products.pro _____ spectra/edge_products.pro
4 util/energy_res.pro _____ spectra/energy_res.pro
5 util/energy_res_define.pro _____ spectra/energy_res_define.pro
6 util/geographic2eci.pro _____ solar/geographic2eci.pro
7 util/get_edge_products.pro _____ spectra/get_edge_products.pro
8 util/get_edges.pro _____ spectra/get_edges.pro
9 system/graphics_devices.tex _____ synoptic/list_synop.pro
10 util/mk_file.pro _____ system/mk_file.pro
11 util/pulse_spread.pro _____ fits/mrdfits.pro
12 synoptic/rpc_get_noaa.pro _____ spectra/pulse_spread.pro
13 display/x2gif.pro _____ rpc/rpc_get_noaa.pro
14 display/x2jpeg.pro _____ image/x2gif.pro
15 _____ image/x2jpeg.pro
16 _____ widgets/ximovie.pro
Enter two indexes for each column to rename, (R)elist, or (F)inish:
```

In this example you would enter: 0 1

The process repeats until there are no more files that have been renamed or moved.

2.7.1 Merging the changes in the vendor drop into your working copy

Suppose you made a SVN copy of the 3rd party software, and made some changes to your copy. Now you want to update your copy to include the updates you just added in the latest 'vendor drop'

From within an idl_socware working copy:

```
svn merge --dry-run $SOCREPOS/idl_external/ssw_gen_idl/2006-12-08 \
  $SOCREPOS/idl_external/ssw_gen_idl/2007-01-25 external/ssw_gen_idl/
```

If things look right, try it again w/o the --dry-run.

2.8 How to contribute code and modifications

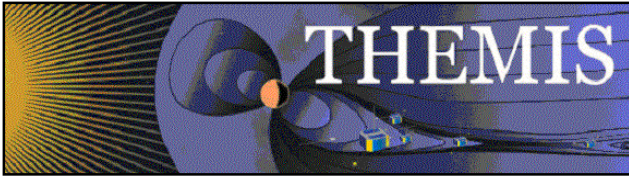
If you want to contribute code to the THEMIS IDL SW distribution, you can email us your routines, or you can become part of the THEMIS development team and work directly with the SVN repository. We can give you access if you provide us with your SSH public key. See the THEMIS SOC SW document for details on working with the THEMIS SVN repository.

Code Check-in Procedure

after checking code in with
svn commit

After you make a commit to the repository, you can update the global workspace /disks/socware/idl by running the following sequence of commands:

```
ssh thmsw@ambrosia
cd idl
svn update
# if you're really conscientious, do some regression testing as
# a generic user (to make sure your new code is not dependent on
# special setting in your account )
ssh thuser@ambrosia # or thuser@wherever
```



```
# test  
exit #thuser  
exit #thmsw
```

```
Create a snapshot:  
cd ~
```