HESSI Data Analysis Software

SSW Installation Database Access Objects

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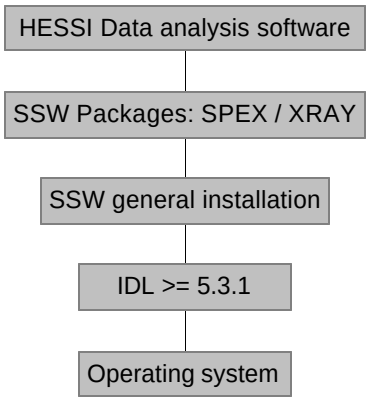
SSW Installation: system components

The data analysis software needs the following components to operate:



SSW Installation

- Different for Windows or Unix/Linux
- Follow instructions. A good starting point is:
  `hessi.ssl.berkeley.edu/software`
- SSW installation:
  `www.lmsal.com/solarsoft`
  - SSW installation instructions for Windows:
    `hesperia.gsfc.nasa.gov/hessi/solar_install/installation.html`
- Test: `IDL> hessi_image`
- In case of problems:
  - Please report
  - Problems may not be (only) in the hessi software

Data access: general

- All data are available on-line
  - Level-0 (telemetry) data
  - Quicklooks
  - Catalogs
- Advantages
  - In some cases the access is fully transparent
  - Local mirror sites are easy to set up and maintain
- Network bandwidth limitation implies different access methods
- Search keys: filename, date, position, size
- Data archive sites:
  hesperia.gsfc.nasa.gov (GSFC)
  hessi.ssl.berkeley.edu/data (UCB, backup)

Access method 1: local archive available

- Data access fully transparent
- Set `HSI_DATA_ARCHIVE` environment variable

  to the location of the archive, e.g.
  `/disks/soleil/data/test_data`
- No further actions required
- Some institutions covered: UCB, GSFC
  - Other local archives?
- Example In IDL:

```
IDL> o = hsi_lightcurve()
IDL> o->Plot, OBS_TIME_INTERVAL=['2000/09/01', '2000/09/02'],
   /LTC_FAST, /LTC_TIME_RES = 60
```

Access method 2: high bandwidth network connection

- Data access may be fully transparent
- Set `HSI_DATA_ARCHIVE` environment variable

  the address/location of the archive,
  e.g.`hessi.ssl.berkeley.edu/test_data`
- The software automatically downloads the files
- For large observation time intervals, better to download in advance
  - ftp access: files sorted chronologically
    - ftp://hessi.ssl.berkeley.edu/test_data
  - web access:
    - direct: `http://hessi.ssl.berkeley.edu/data/test_data`
    - query form: `http://hessi.ssl.berkeley.edu/data/`
  - Covers many academic institutions

Access method 3: low bandwidth network connection

- Download of data files will be slow
- Need to limit the observation time interval to a minimum
- Download only a limited number of files
- One way around: CDs/DVDs
- Possibility of transferring parts of data files
- On-line data analysis capabilities at HEDC:

  `www.hedc.ethz.ch`

HESSI Data Analysis Software:

Objects: why, what, and how

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Why use objects?

- HESSI data analysis software is a complex system:
  - Uses level-0 data
  - Many reconstruction steps: unpack, calibrate, back-project
  - Many generated data types: event lists, back projections
  - Many parameter settings like energy/time resolution, angular resolution, etc., are chosen at run-time
- Efficiency:
  - Reuse already generated data and recompute them only if necessary, e.g. the modulation patterns do not need to be regenerated when the imaging algorithm changes
- Simplicity: consistent interface for all data types
- Software reusability:
  - Different parts of the software can use the code, e.g imaging algorithms can reuse the same “frame”
  - Less lines of code is better

Why: object-orientation

- Objects provide syntactic structures for building complex systems
  - Consistency:
    - Allow implementing consistent data management
  - Maintainability:
    - Deals with specific data types only locally
  - Exchangeability:
    - New procedures can easily replace old ones
  - Reusability:
    - Different data types can share some code
- Objects are better than procedures:
  - Contain the same functionality...
  - .. and extend the procedural approach

What: object-oriented concepts

- Object: a way of reserving part of the computer memory for the management of a specific data type

```
rectangle = {rectangle, $
  xmin:0., xmax0., ymin:0., ymax:0.};
function rectangle::area
   return, (xmax-xmin)*(ymax-ymin)
end
```

- Object gets instanciated (memory allocation)

```
IDL> o = Obj_New( 'rectangle', 0, 10, 0, 34 )
IDL> print, o->area()
```

  - we can have as many instances as we want

- Object can be extended using inheritance

```
filled_rectangle = {filled_rectangle,
  color: 0B, INHERITS rectangle}
PRO Filled_Rectangle::Display
```

What: object features

- Consistency:
  - `filled_rectangle` uses the same procedures as `rectangle`
- Maintainability:
  - `xmin`, `xmax`, `ymin`, `ymax` managed only in `rectangle`
- Exchangability:
  - redefine `area()` for another coordinate system
- Reusability:
  - code for `area()` is only used once
- Persistency:
  - Values of `xmin, xmax, ymin, ymax` exist as long as the object instance exist

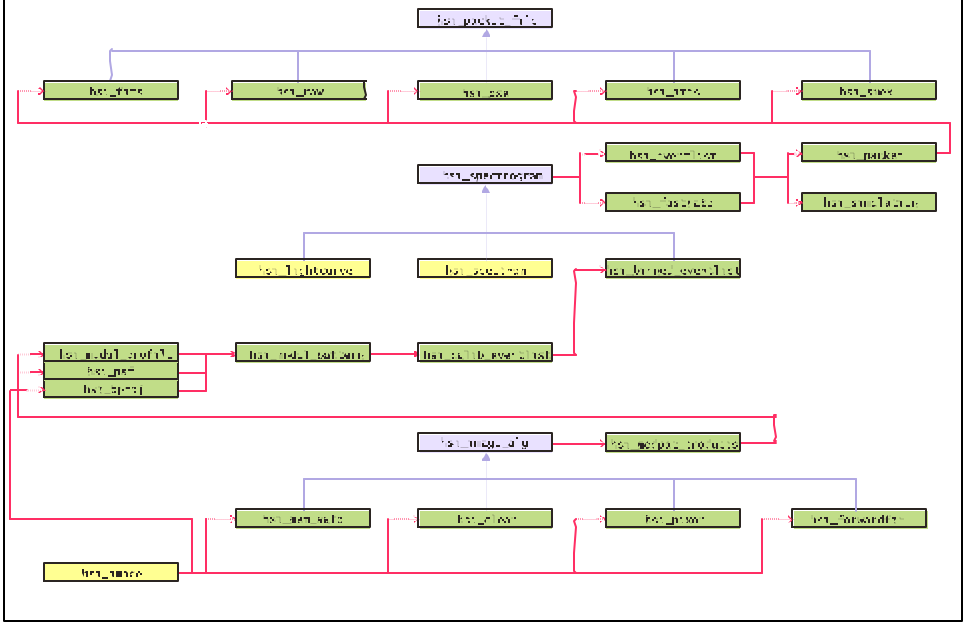
How: usage with HESSI

- The HESSI data analysis software uses objects to stepwise reconstruct an image or a lightcurve or a spectrum
- Each data type used in the reconstruction is associated with an object
  - telemetry packet, event list, calibrated event list, image algorithms, etc.
- Each data type is an instance of a single framework object which provides the functions to access the data
- Objects are linked together
  - e.g. clean image algorithm object uses data from the back projection object

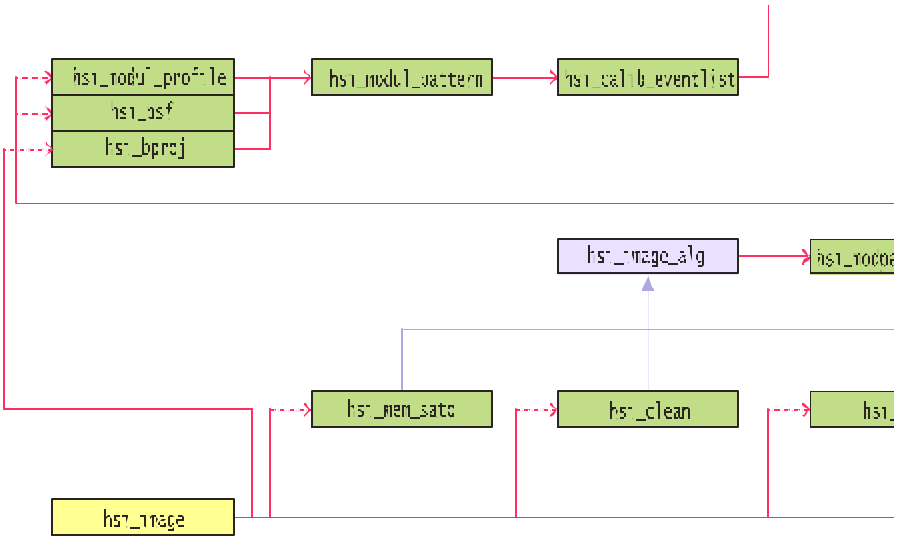
How: stepwise reconstruction

- Reconstruction of an image:
  - Read in data packets
  - Unpack data for time and energy range
  - Bin data
  - Associate calibration for specific position
  - Calculate modulation patterns
  - Calculate back projection

HESSI Object diagram



HESSI Object diagram (cont)



Advantages

- Each object provides the same functions to access the data:

```
o1 = hsi_image()     o2 = hsi_spectrum()  o3 = hsi_lightcurve()
im = o1->getdata()   sp = o2->getdata()   lct = o3->getdata()
```

- Consistent interface: software will work the same way for any data type
- Objects gives an access mechanism to all the intermediate data
- Few commands

Conclusion

- Object-oriented code is the best way to code
- Easier to use as procedural code
- More flexible as procedural code
- Hopefully will simplify the HESSI data analysis and increase the scientific return of the mission