

SPIRE

SUBJECT: SPIRE Trend Analysis Requirements

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Project Document

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Glossary

| | |
|-------|---|
| DP | Data Processing |
| IA | Interactive Analysis |
| ICC | Instrument Control Centre |
| S/C | Spacecraft |
| SPG | Standard Product Generation |
| SPIRE | Spectral and Photometric Imaging REceiver |
| TC | Telecommands |
| TM | Telemetry |

1. SCOPE

2. DOCUMENTS

2.1 Applicable Documents

2.2 Reference Documents

3. INTRODUCTION

The trend analysis system provides facilities for both monitoring the long term trends in instrument parameters and calibration information, and for analysis of these trends in an interactive environment.

The system should therefore provide for selection and extraction of the data from any source available, interactive processing and analysis of the results.

3.1 Terms

Data is available in three forms:

- **Raw** data is the data as held in the TM/TC or S/C databases as received/sent to the satellite
- **Converted** means the data after conversion to engineering values.
- **Processed** means data created during observation processing steps in the pipeline.

4. FUNCTIONAL REQUIREMENTS

4.1 Data Extraction

4.1.1 Data Sources

TA-F-EXT-0100: It shall be possible to extract data from the following sources:

- the downlink TM database,
- the Standard Processed Data products,
- the Proposal Handling System,
- the uplink database,
- the spacecraft database.

It is assumed that any intermediate products generated by SPG, and other pipelines, will be stored as Standard Processed Data products even if not provided to users – e.g offset history product.

TA-F-EXT-0110: It shall be possible within one query to extract data from more than one of the data sources.

TA-F-EXT-0120: It shall be possible to specify the data is to be extracted from:

- A product or set of product types
- A data source as given above

4.1.2 Data Selection

TA-F-EXT-0200: It shall be possible to select the data to be extracted based on one or more of the following criteria:

- Time Period(s)
- Parameter name list
 - *Parameters are named entities and include product metadata, product dataset columns, TM parameters*
 - *It should be possible to use wild cards in parameter names*
 - *OBSID, BBID and BBtype are parameters*
- Location within a TM packet or dataframe

- *This covers values not identifiable by name, such as values in TM header fields*

TA-F-EXT-0210: It shall be possible to select (both raw and converted) data outside an observation. *If a time period is selected all data should be available even if it is not associated with an observation*

4.1.3 Data Output

TA-F-EXT-0300: It shall be possible to choose for a query to return either complete processed data products or a product containing the selected parameter (or set of parameters). *It is assumed that the extracted data will always be returned in the form of a parameter product*

TA-F-EXT-0310: It shall be possible to choose for a query to return raw, converted and/or processed data in a parameter product

TA-F-EXT-0320: All returned parameter products shall contain the spacecraft time for each data sample.

TA-F-EXT-0330: It shall be possible to request the result(s) of a query to be returned as

- A file (on the requesting computer)
- A product in a JIDE session
- A list of products matching the query

4.1.4 Data Filtering

TA-F-EXT-0400: It shall be possible to filter the extracted data within the query by

- Providing simple logic for each parameter selected
e.g. value gt X and lt Y or value = Z
- Providing criteria for other parameters
e.g. extract parameter A when parameter B equals, is less than, is greater than N. It should be possible to combine simple statements with AND, OR etc.
- Providing a sampling rate
Examples are: all, every n seconds/mins/hour, every observation, every BBtype
- Using a parameter's timeline

TA-F-EXT-0410: It shall be possible to process data before it is returned from a query in the following ways:

- Return sampled data averaged over the sample interval
- Interpolating parameters sampled at different rates on to a single parameter timeline

4.1.5 User Interface

TA-F-EXT-0500: The user shall be able to make a query using a query language

TA-F-EXT-0510: The user shall be able to make a query through a GUI for simple queries

It is desirable that simple queries for parameter timelines are supported via a graphical interface e.g. similar to the Export tool. To use such a tool a user should be able to enter:

- Time Period
- AOT type(s)

- Parameter names (preferably from menus)
- Simple logic for each parameter selected (e.g. value gt X and lt Y or value = Z)
- Parameter sample rate (all, N minutes/hours/days)
- Download option (filename or IA option)

TA-F-EXT-0520: The GUI shall provide the following operational facilities:

- A progress bar so that you know how far the tool has got (could be very useful if the query is going to take a long time)
- Memory usage bar giving the % used and also the absolute amount used in Mb (absolute amount is needed so that you can tell if you started the tool with the wrong memory allocation).
- A stop/clear button so that if you make a mistake in specifying a query/ a query takes longer than expected/ memory is all used etc., you can stop the current query and reset everything (including memory usage) without having to kill and restart the tool (and therefore without losing all the settings that you just typed in).
- The ability to save standard input settings in a file and load this as a query (ie. this would mean that you could repeat a query and be absolutely sure that you used identical input parameters as previous time).
- After finishing a query memory usage should be reset to the level it was before the query was started, ready for a second, third, fourth... query in the same session.

TA-F-EXT-0530: It shall be possible to make a query from a standalone process running at the ICC
For example, this will allow processes to be run automatically:

- *to generate new daily files*
- *to append to trend files*

TA-F-EXT-0540: It shall be possible to make a query from a JIDE session.

The results should then be returned as an object which can be processed in that session

4.1.6 Examples

The following are examples of the use of the TA extraction system, which should all be possible with the system defined in this section

- Return BSM rest position once per hour over the whole mission (needs an automated way of knowing that SPIRE is not performing an AOT where the BSM is moved). A query would need to say AOT not X, Y or Z, want BSM chopposn and jiggposn, once per hour, start time and end time or give me all
- Return SUBKTEMP once per minute over any given 24 or 48 hour period
- Return MCUENG parameter as fast as generated from an engineering observation (very fast!)
- Return SMECLVDTPOSN when SMECENCPOSN is in a given range over a 24 hour period one year ago
- Return SCAL2CURR and SCAL2TEMP, once per 10 minutes, when SCAL2TEMP is greater than 80K for the whole mission
- Return all values of BSMCHOPPOSN and BSMJIGGPOSN when BSMCHOPPOSN is greater than 50,000
- Return all values of PUMPHSTEMP one hour before and one hour after and during each occurrence of the PUMPHSTEMP reaching 20K (extracts cooler recycles)
- Return Flux on one pixel from PCAL flashes for one month/mission (extract derived fluxes)

- Return average temperature of thermistors during each day over the mission (extract all the derived temperatures then average it for the day)
- Return all the values of derived detector parameters from all the AOTs of a given type throughout the mission, at a rate of once per AOT, time plus 288 columns for the photometer file produced, separate time plus 72 columns for the spectrometer file produced.
- Return all products for a given AOT for a given time period.
- Return all level 1 products, (both photometer and spectrometer) for a six month period which match the criteria SUBKTEMP greater than 290mK.
- Return all channel derived tables (intermediate product which should be stored) for a one month period.
- Return all Small or Large map products for a given RA and DEC range (area on sky)
- Return all high resolution spectrum products where the number of scans is greater than 100.
- get all interferogram/spectrum products where the interferogram is flagged as being clipped/saturated at ZPD

4.2 Analysis

The DP system will be used to interactively analyse the results of trend queries. The following is a list of functionality which is expected:

TA-F-ANAL-0100: It shall be possible to automatically generate plots from trend data

Examples:

- *I have a batch job which produces a file of all average flux levels on detector PSWE8 from each PCAL flash that day. The batch job also produces a plot of flux level vs time which is stored alongside the file.*
- *My batch job extracts average SCAL2TEMP and SCAL2CURR over each hour SCAL2 is switched on over each week. At the end of each week it automatically produces a plot of SCAL2TEMP plotted against SCAL2CURR*

TA-F-ANAL-0110: It shall be possible to plot two parameters (telemetry and/or DP) against each other for any specified time period and sample rate.

Examples:

- *Plot BSM CHOPPOSN against BSM JIGGPOSN from the rest position file, colour those before a certain date blue and those after a certain date red.*
- *Plot thermistor temperature on SSW (derived during processing) against SCAL2TEMP*

TA-F-ANAL-0120: It shall be possible to put timeline plots together i.e. as QLA does when multiple parameters are selected

TA-F-ANAL-0130: The following DP functionality shall be provided:

- Plot manipulation
- Application of algorithms
- Ability to export data in suitable format for other packages
E.g. FITS

TA-F-ANAL-0140: It shall be possible for trend files to be updated from the analysis system

Subject to access rights

4.3 Storage System

A storage system is required to hold the trend data generated by automatic and interactive extraction and processing of trend data

TA-F-STR-0100: The storage systems shall:

- Allow easy identification of daily trend files
- Allow easy interface to IA system e.g. using product browser
- Allow extraction of specified data from multiple files e.g. SUBKTEMP at 5 hours after recycling has finished, from each daily file, for every day **during the mission**

5. PERFORMANCE REQUIREMENTS

TA-PERF-0100: It shall be possible to perform a query and return the data for up to 10 parameters over a time period of up to 1 week in less than 5 minutes

TA-PERF-0110: it shall be possible for the analysis system to handle trend data products consisting of up to 1,000,000 samples of 300 parameters

Actual maximum size is TBC