SPIRE Fourier Transform - User Guide

SPIRE-UOL-REP-??????

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1. Background

Work Package Fourier Transform is a series of modules that reduce data from the SPIRE FTS. The inputs to the package are Spectrometer Data Products that are produced by the Engineering Data Process (EDP). The output of the package is a Spectrometer Detector Spectrum (SDS) Product. This package is located in Herschel IA under *herschel.spire.ia.modules.ft*. The following structure is used for the package:

herschel
spire
ia
modules
ft - Contains all pipeline module tasks.
defns - Contains default configuration properties in ft.xml.
doc - Contains FT documentation.
gui - Contains GUI classes.
util - Contains utility classes. Some utility classes are used by pipeline tasks, while developers or users may use others.

For a detailed description of Fourier Transform package modules, see Javadoc and the function guide[1].

2. How to Run the Fourier Transform Package

There are two ways to run the Fourier Transform package:

1. **Jython Scripts.** There are **FTScript** – This Jython script allows you to open saved EDP products, as well as an Optical Encoder at ZPD calibration product, and process them. The benefit of using the script is the increased flexibility that Jython provides. The drawback of using the script is that Configuration properties must be set manually or by calling *herschel.spire.ia.modules.gui.FTPropertyMenu.*
    a. **ConvertExportFITStoEDP.** This script converts data products created with the **Data Export Tool** so that they resemble data products produced by the **EDP**. Edit the script to set the paths to values appropriate for your system. See §3 below for a further explanation of this script.

[1] "*Function Guide for the Fourier Transformation Package*", SPIRE-UOL-REP-002220

b. **MakeOECalibrationProduct.** Use this Jython script to create a Calibration Product that contains the SMEC Optical Encoder (OE) value corresponding to the position of zero optical path difference (ZPD) for each pixel. Edit this script to set the paths to values appropriate for your system as well as to set an appropriate value for the SMEC OE at ZPD.
c. **FTScript**. This Jython script allows you to open saved EDP (or psuedo-EDP) products, as well as an Optical Encoder at ZPD calibration product, and process them using all or parts of the FT package. Please consult the FT package function guide[2] for details on the individual functions available in the Fourier Transform package. The benefit of using the script is the increased flexibility that Jython provides. The drawback of using the script is that Configuration properties must be set manually or by calling *herschel.spire.ia.modules.gui.FTPropertyMenu.*
d. **ConvertExportFITStoEDP_loop** and **FTScript_loop.** These Jython scripts the same functions as **ConvertExportFITStoEDP** and **FTScript** but do so on data for a series of observations (**N.B.** Due to running memory issues, it is advised that the loop scripts only be run on low-resolution spectrometer observations).

2. **FTExecuter.** This Java GUI, located in *herschel.spire.ia.modules.gui*, allows the user to define input and output file paths, select and configure processing steps, and output and visualize results of pipeline steps. To run this GUI, type:
```
from herschel.spire.ia.modules.ft.util import *
FTExecuter()
```
in a Jython console.

3. EDP Products

The Engineering Data Process provides the three data Products required as input to the Fourier Transform package:

1. Spectrometer Detector Timeline (SDT) – Contains bolometer signal information.
2. Spectrometer Mechanism Timeline (SMECT) – Contains stage position information.
3. Housekeeping Timeline (HKT) – Contains housekeeping information. For the current implementation of the Fourier Transform package, the only information required from the HKT is the SMECSTAT timeline, which keeps track of the scan number.

(N.B. In future implementations, a Pointing Timeline product will also be required).

The products listed above are produced by the Engineering Data Process and are required by the Fourier Transform package. If the EDP is not available to create these products, there is an alternate way to create these products. The script **ConvertExportFITStoEDP** may be used to convert FITS files created with the SPIRE **Data Export Tool** into "psuedo-EDP" products. The script uses FakeEDPFactory, located in *herschel.spire.ia.modules.ft.util*, which creates empty products mimicking the format of

[2] "*Function Guide for the Fourier Transformation Package*", SPIRE-UOL-REP-??????, 25 July 2005

the proper EDP Products. The script then copies the data from the products produced by the **Data Export Tool** into the pseudo-EDP products. These newly created products can then be used by the Fourier Transform package.

For more information on the data products see the SPIRE Data Products document[3] (available on the SPIRE Bulletin Board → Data Products → SPIRE Data Product description document Ver. 1.4).

4. Calibration Products

Calibration Products are used in various steps of the pipeline. Calibration Products are generated by CalibrationProductFactory, located in the folder *util.* Calibration Products are currently stored in a Product array, which is also generated by CalibrationProductFactory. The location of each product in the array is defined by a map, which is itself defined in CalibrationProductFactory. A description of the calibration products used by the Fourier Transform package is given in Table 1.

Name	Array Index	Description	Where Used	Required
Band Limit	BL_MAP	Contains band limits for SLW and SSW	RegSampledPhaseCorrection	N
Bad Pixel	BP_MAP	Identifies bad pixels not to be processed	RegSampledIfgmCreation	N
Bad Scan	BS_MAP	Identifies bad scans not to be processed	RegSampledIfgmCreation	N
Lvdt OPD	LVDT_OPD_MAP	Scale for converting LVDT DC to OPD	RegSampledIfgmCreation	N
Oe OPD	OE_OPD_MAP	Scale for converting Optical Encoder position to OPD	RegSampledIfgmCreation	N
Phase	PHASE_MAP	Provides known instrumental phase	RegSampledPhaseCorrection	N
ZPD Lvdt	ZPD_LVDT_MAP	Location of ZPD in LVDT DC (per pixel)	RegSampledIfgmCreation	N
ZPD Oe	ZPD_OE_MAP	Location of ZPD in OE (per pixel)	RegSampledIfgmCreation	N

Table 1: Fourier Transform package calibration products.

5. Configuration Properties

Configuration properties for the Fourier Transform package are located in the Configuration path spire.ia.modules.ft. Each task in the Fourier Transform package has its own subtree (e.g. properties for the IfgmCreation Task are located in spire.ia.modules.ft.ifgmcreation). In addition to task specific properties, there are some properties that apply to the entire Fourier Transform package.

Table 2 describes the general configuration properties, which are located in spire.ia.modules.ft. The GUI and Script columns indicate whether a given property is used by the FTExecuter GUI and FTScript, repectively. Other properties are in place but

[3] "SPIRE Data Products", version 1.4, 04 May 2005

currently do not have any effect on the data processing. For example, the intype and outtype properties indicate the file format of the saved input and output products. The current implementation of the Fourier Transform package software is only set up to handle FITS file formats.

Name	Description	GUI	Script	Default
intype	Format of input products.	N	N	
outtype	Format of input products.	N	N	
inpath	Path of input products	Y	N	
outpath	Path to output products, and logging file	Y	N	
rootname	Name that identifies a group of EDP products belonging to the same observation. Input files must contain this name and output files will also contain this name.	Y	N	ROOT_NAME
loglevel	Level of messages to log. Levels are defined in *java.util.logging.Level*	Y	Y	WARNING
edpexamine	Boolean indicating whether or not to examine EPD products with PixelScanMasker prior to running the pipeline.	Y	N	false

Table 2: Fourier Transform package: General properties.

The properties that are common to each module in the Fourier Transform package are shown in Table 3. These properties appear under each spire.ia.modules.ft property subtree. As an example, the saveplot property appears under spire.ia.modules.ft.ifgmcreation and spire.ia.modules.ft.driftremoval.

Name	Description	GUI	Script	Default
saveplot	Boolean indicating whether to save plots useful for task debugging to a *herschel.spire.ia.modules.ft.util.DebugProduct*. If true, the DebugProduct is accessible from the "debug" output TaskParameter after the task has executed. DebugProducts may be inspected by using *herschel.spire.ia.modules.ft.gui.ProductBrowser*.	Y	Y	false
saveresult	Boolean indicating whether to save task result to FITS. Save location is defined by spire.ia.modules.ft.outpath (see above).	Y	N	false
execute	Boolean indicating whether to run the task or not.	Y	N	Default depends on the task.
visualize	Boolean indicating whether to view the task result using *herschel.spire.ia.modules.ft.gui.PixelViewer*.	Y	N	false

Table 3: Fourier Transform package properties common to each Task.

Properties specific to individual Fourier Transform package tasks are presented in Table 4.

Task	Sub-package	Name	Description	Default
RegSampledIfgmCreation	ifgmcreation	useOECalibration	Boolean indicating whether to use ZPD_OE calibration for ZPD location.	true
		interpoltype	Type of interpolation to use during re-gridding	SPLINE
DriftRemoval	driftremoval	polydegree	Degree of polynomial to fit interferogram to. Generally, use 1st degree low-res scans and 2nd degree for high-resolution scans.	2
IfgmDeglitcher	deglitch	type	Type of deglitching to use. Deglitching is still in development so types are likely to change.	STDDEV
RegSampledApodization (pre)	preapod	apodfunction	Apodization function to use.	aNB_15
RegSampledFT (double-sided)	dsft	zeropad	Boolean indicating whether or not to zeropad interferograms	true
RegSampledPhaseCorrection	phasecorrect	polydegree	Degree of polynomial of phase fit	1
		pcfapodfunction	Apodization function to be performed on PCF	aNB_15
		pcfsize	Size of truncated PCF	256
RegSampledApodization (post)	postapod	apodfunction	Apodization function to use.	aNB_15
RegSampledFT (single-sided)	ssft	zeropad	Boolean indicating whether or not to zeropad interferograms	true
SpecCoaddition	speccoadd	separateupdown	Boolean indicating whether coadd up and down scans separately.	false

Table 4: Fourier Transform package properties specific to individual Tasks.

6. Visualization Tools

Three Graphical User Interfaces (GUIs) have been developed for visualizing and inspecting data products. Each GUI class is located in *herschel.spire.ia.modules.ft.gui* and is useful for specific situations. In the current implementation, each GUI runs as a blocking dialog. Table 5 describes the GUIs:

Name	Applicable Products	Description	Jython usage
ProductBrowser	SDI, SDS, DebugProduct	Provides a tree view of datasets on the left side of the GUI. Plottable nodes appear as leafs in the tree. Clicking on the node displays the plot on the right side.	ProductBrowser(prod)
PixelScanMasker	EDP Products	This GUI allows user to view raw bolometer signal, stage position, and LVDT DC. In addition this GUI can be used to create Bad Scan and Bad Pixel calibration (see §4).	PixelScanMasker(sdt, smect, hkt)
PixelViewer	SDI, SDS	Provides a visual representation bolometer arrays. Bolometers are colored in gray according to intensity of the selected scan and slice in OPD or Wavenumber. Clicking on a pixel displays a plot.	PixelViewer(prod)

Table 5: Description of Fourier Transform package GUIs.

For more information on the visualization tools, see the Javadoc.