IF Generation Algorithm

Overview

The I/F algorithm is applied to resampled OVIRS calibrated radiance spectra to obtain the surface reflectance, after thermal component has been removed (thermal excess-removed reflectance spectra MRD-140); at any temperature expected for Bennu, the thermal component is negligible for wavelengths shorter than 2 microns. The surface reflectance is obtained simply as the ratio of the resampled OVIRS calibrated radiance spectrum to the standard solar radiance spectrum being used by the OSIRIS-REx mission 'OrexSolarOVIRSres.20150302b.txt' (see References, below), which has been sampled to a 2-nm equal spacing from 392 nm to 2400 nm and 5-nm spacing from 2400 nm to 4340 nm (extra rows were removed). The final uncertainty in I/F has been computed using the standard error propagation formula. This algorithm will run as part of the SAWG pipeline on all spectra. If run outside the pipeline, the input can be any resampled radiance spectrum, as shown below.

Algorithm Description

1. Read in resampled OVIRS calibrated radiance spectra (the algorithm does not distinguish between original calibrated radiance spectra or thermal tail-removed radiance spectra - however, the latter is the intended default pipeline input) along with associated radiance uncertainties and wavelengths, as well as the appropriate solar range (header keyword SUN_RNG), assumed to be in units of km.
2. Run IDL routine IoverF using pipeline calibrated OVIRS radiance spectra as input. It is assumed that the reference solar spectrum file exists in the same directory as the algorithm and both have proper units.
3. The I/F algorithm is meant to be called from another routine or at a command line. If done as part of the SPOC pipeline, the header from the original file would still apply, just with a change to units keywords and a list of reference files applied. See below for notes about I/O.

Example

Running the algorithm from an IDL command line or called as a subroutine, yields a vector of values at the OVIRS wavelengths (range can be truncated). It is assumed that the reference files are in the same directory, and that the spectrum to be converted has been read into a variable. The format is:

```
 r = IoverF(radiance, error, sunrange, wave1, wave2)
```

Example Usage:

```
IDL> ovirs_cal_rad=readfits('filename.fits')  ; Note the FITS format and read algorithm to obtain keywords TBC
```

```
IDL> r = IoverF(ovirs_cal_rad, ovirs_error, sunrange, 0.6, 1.5)       ; convert to I/F over the range 0.6 to 1.5 microns
```

Yields an output:

r: a double precision array of *nx3* elements, where *n* is the number of spectral elements between wave1 and wave2; *n*=1393 for a full spectrum. First column is wavelength in nm, second column is radiance, third column is the resultant uncertainty.

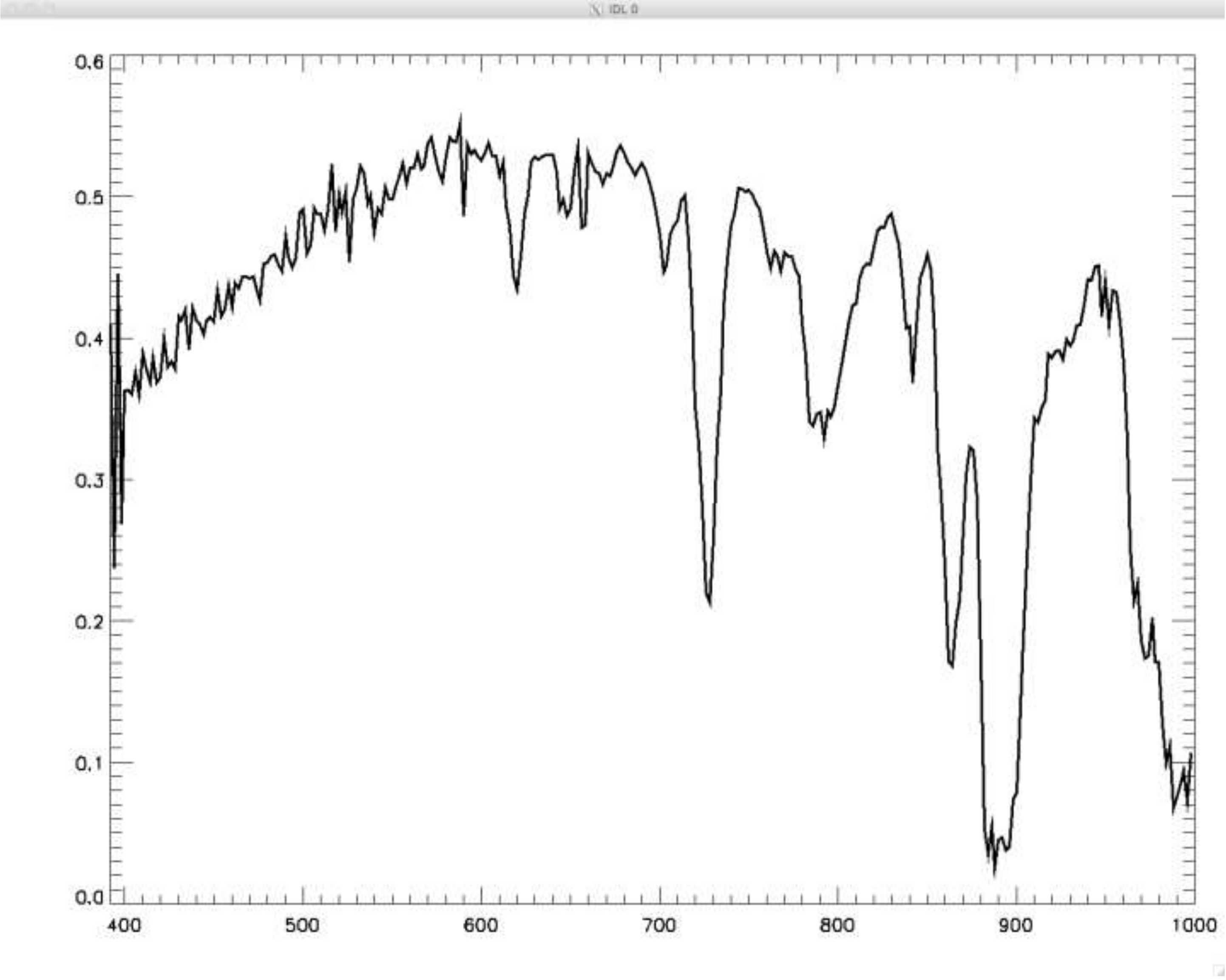
Example 1:

Read in sampled Jupiter spectrum, use resampled solar spectrum, and convert to I/F from 0.392 to 1.0 microns. Sun range = 5.2 AU

```
IDL> readcol,’jupiter_sampled_radiance.txt’,wavej,radiance       ; read in test data

IDL> sunrange=1.496E8*5.2

IDL> errorj=fltarr(1393)

IDL> errorj(*)=0.01*radiancej(*)                                    ; make 1% errors

IDL> r=Ioverf(radiancej,errorj,sunrange,0,1.0)                     ; call function
```

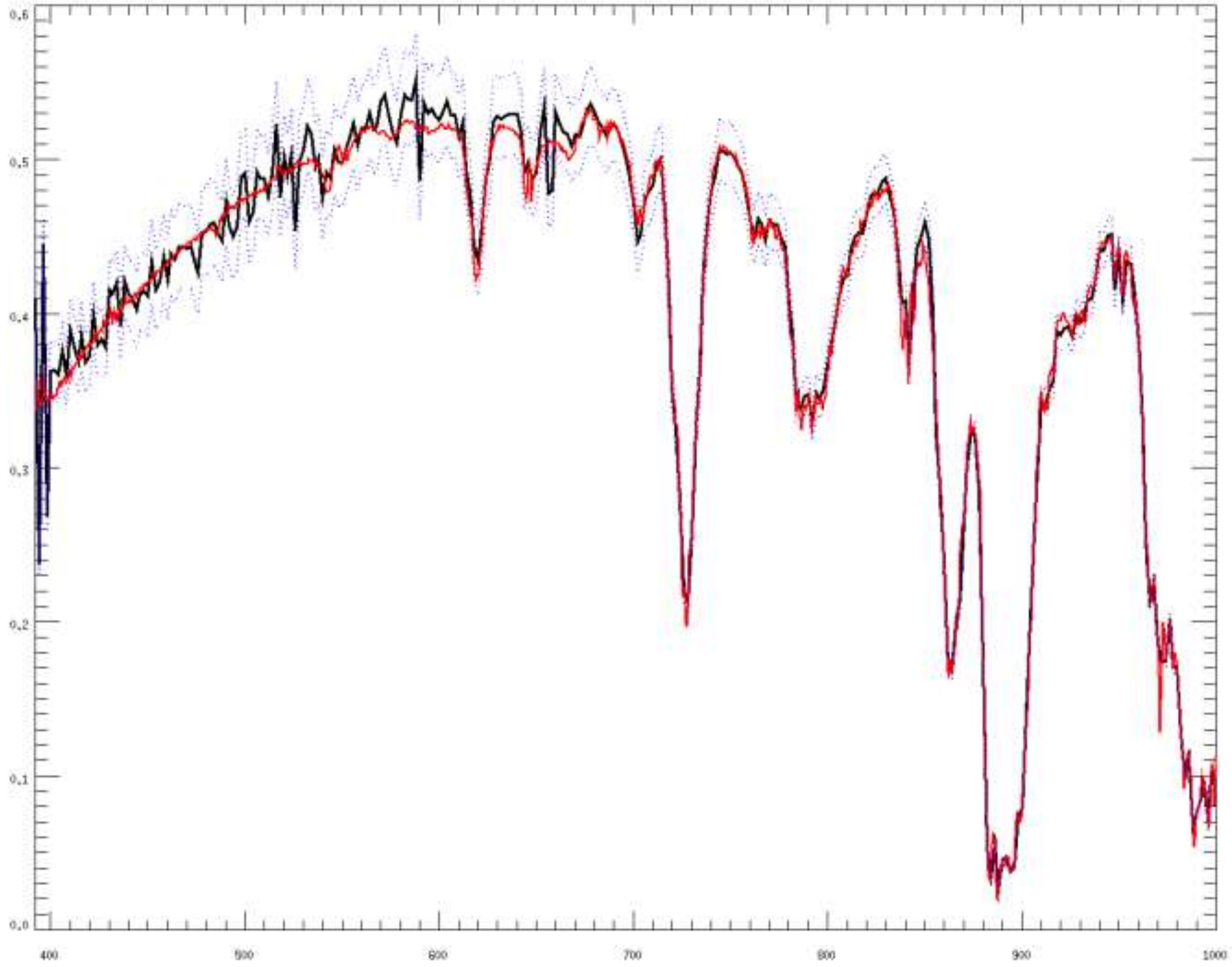
Output should be a vector, with wavelengths from 0.4 to 1.0 microns that match Jupiter’s reflectance spectrum:

```
 IDL> plot,r(*,0),r(*,1), xsty=1,xra=[392,1000]                     ; plot output
```



Comparison with an unresampled Jupiter I/F spectrum shows a good match (red line, note a different solar model is assumed). These are well bracketed by the calculated uncertainties (dotted blue lines):

```
IDL> readcol,'jupiter_orig',wavej2,jup ; read in test data
IDL> oplot,wavej2*1000,jup,color=250   ; overplot spectrum
IDL> oplot,r(*,0),r(*,1)-r(*,2),color=50 ; overplot uncertainty
IDL> oplot,r(*,0),r(*,1)+r(*,2),color=50 ; overplot uncertainty
```


0,6
0,5
0,4
0,3
0,2
0,1
0,0
400
500
600
700
800
900
1000