

## Description

This algorithm takes input data in units of I/F (also known as RADF, or Radiance Factor) - observations obtained as a function of bidirectional reflectance viewing geometry angles (incident light, emitted light, and phase angle) and models the observations to determine a function that predicts reflectance as a function of incidence, emission and phase angle. This model is later used to "correct" the data for photometric effects that depend on viewing geometry by scaling the data to a common reference viewing geometry (See "Photometric Correction" Algorithm and Data Product Descriptions). This makes it possible to compare images and spectra obtained at different times of day.

0. Collect OVIRS data from stations from Detailed Survey: 12:30, 10:00am, 3:00pm, and 6:00pm (or 6:00am)

1. Make sure all data files have associated SPICE and pointing information (geometric information from the best available reconstructed SPICE and Shape Model at the time of data download).

2. Open an OVIRS Spectral Sequence FITS file that contains all of the following information:

- a. I/F and I/F error, per channel
- b. SCLK
- c. Incidence angle at bore site(degrees)
- d. Emission angle at bore site (degrees)
- e. Phase angle at bore site (degrees)
- f. FOV Fill Factor (% for imaging; 1=full 0=empty and 2=partial for spectra)
- g. Flag: Limb (0=no, 1=yes)
- h. Flag: Terminator (0=no, 1=yes)
- i. SNR
- j. Range to Target (m)
- k. Range from Sun to Target (km)
- l. Latitude (bore site)
- m. Longitude (bore site)
- n. Spatial Resolution: Spectrum footprint radius (m)

3. Using the above file, apply data selection criteria:

- a. Maximize the phase angle range
- b. Minimize the spatial resolution range
- c. Restrict incidence angle range to between 0 and 75 degrees
- d. Restrict emission angle range to between 0 and 75 degrees
- e. FOV Fill Factor:
  - i. Restrict Spectral FOV to full (1 is full, 0 is empty and 2 is partial)
- f. Select highest available SNR per image (per spectrum) in the case that overlapping images (spectra) are available for the same area
- g. Consider limb and terminator flags - include or reject as necessary

4. Check the geographic coverage: minimize overlapping data and maximize spatial coverage

Note: the best file format for checking geographic coverage will be a lat-lon grid map that shows the location of the central pixel for each data file used in the photometric model dataset. Such a map could be a very simple

cylindrical projection stored as a bitmap, or as a .gif image file, such as is produced in IDL.

5. Make a photometric modeling dataset (subset of the Detailed Survey Spectral Sequence files above) that include the data that meet the criteria in Steps 3 and 4 above – call these the “Spectral Photometry Data Information File”: SPDIF
6. Fit the SPDIF files (for each wavelength) using a program that optimizes a fit to each of the three chosen photometric models with the optimization routine in IDL called "MPFIT":
  - a. Lommel-Seeliger
  - b. ROLO
  - c. Minneart
7. Create a Log file that matches the SPDIF and includes:
  - a. Data selection criteria
  - b. Notes
  - c. Model functions
  - d. Optimization methods
  - e. Time it took to generate the models (per each)
  - f. Ranking of all models calculated
  - g. Goodness of fits plots (PDF) for each model generated for each wavelength
  - h. Identification of BEST FIT model
  - i. Person who generated models
  - j. Date and Time of modeling

Note: the best file format for a Log file will be an ASCII TXT file with results of, and details of the execution of, each photometric model.
8. Using the original data from step 2, test the BEST FIT model against ALL the data (not just the SPDIF Photometric Data Sets) and iterate if necessary.
9. Make sure to check that the fits converge for each wavelength separately.
10. If the BEST FIT model does not work for all the data, test the second best fit model, and continue down the ranking until all models are tested. A model is good enough for all the data if the discrepancies are random (not systematic) and if the scatter in the discrepancies does not exceed TBD %.

## References

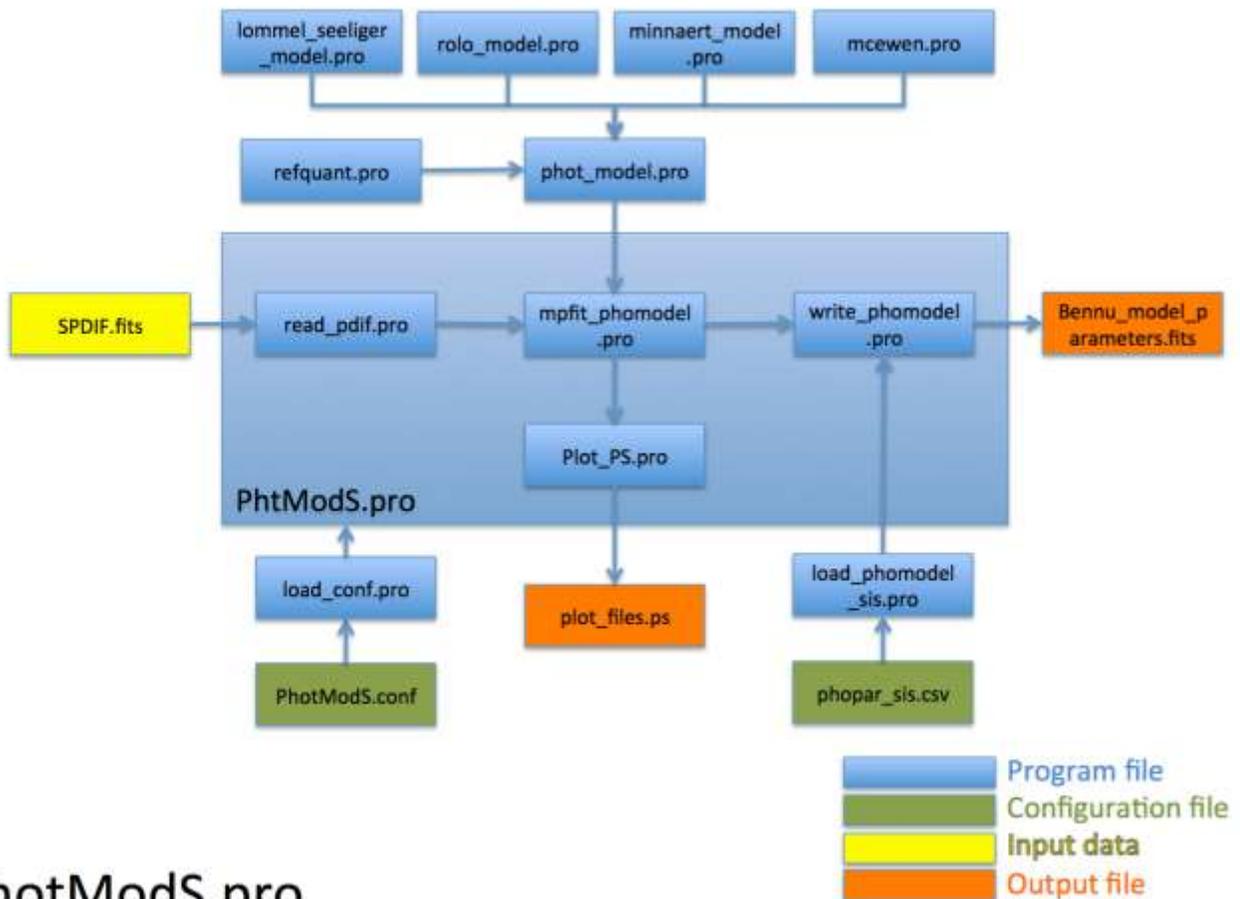
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- Clark, B.E., J. Veverka, P. Helfenstein, P.C. Thomas, J.F. Bell III, A. Harch, M.S. Robinson, S.L. Murchie, L.A. McFadden, C.R. Chapman (1999) NEAR Photometry of Asteroid 253 Mathilde. *Icarus* 140, 53-65.
- Helfenstein, P., J. Veverka, P. Thomas etc. B.E. Clark etc. (1994) Galileo Photometry of Asteroid 951 Gaspra. *Icarus* 107, 37-60.
- Takir, D., B.E. Clark, C.D. d'Aubigny, C.W. Hergenrother, J.Y. Li, D.S. Lauretta, and R.P. Binzel (2015) Photometric Models of Disk-Integrated Observations of the OSIRIS-REx Target Asteroid (101955) Bennu. *Icarus*. [Volume 252](#), 15 May 2015, Pages 393–399.

# Installation, Program Files, User's Guide, and Test Data

## PhotModS.pro - for Spectral Data

The Photometric Modeling Software used for the OVIRS Spectrometer data is written by Jian-Yang Li, tested by Xiao-Duan Zou, and directed by Beth Clark.

Logic Flow Diagram for this Version of the Software:



PhotModS.pro