ALG-AP-008: Determination of rotation period of Bennu and natural satellites

Authors:

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History:

- 2013-July-30 - Draft
- 2013-Nov-05 - Baseline
- 2016-Mar-28 - minor modifications

Description:

Time-series photometry of Bennu will be acquired during the Approach phase. The photometry will cover a span of ~4.5 hours on one day and ~4.5 hours on a second day. As the asteroid rotates, its brightness will vary as the area of its surface facing the spacecraft changes. A fourier analysis of the varying photometry will be used to determine the period of rotation (period of the lightcurve pattern repeating) and shape of the lightcurve. Lightcurve photometry will be obtained in all four MapCam ECAS colors. Four independent color lightcurves will be measured. These results will be compared with rotation state observations obtained with ground-based telescopes prior to Encounter.

Parameters:

infile – Bennu or Natural Satellite time-series lightcurve photometry covering 4.5 hours spans obtained on multiple dates

outfile – Unphased lightcurves (in all 4 color filters), phased lightcurves (in all 4 color filters), rotation period and lightcurve parameters (in all 4 color filters) [data product formats are in UA-SIS-9.4.4-308 - OSIRIS-REx Astrometry and Photometry Derived Products SIS]

Algorithm equations:

The period, amplitude and shape of an asteroid lightcurve is solved using a Fourier analysis of the form:

$$V(t) = C_0 + \sum_{n=1}^{m} C_n \cos \frac{2\pi n}{P}(t - t_0) + S_n \sin \frac{2\pi n}{P}(t - t_0), \quad (1)$$

where V(t) is the computed reduced magnitude at time t;

t is the time of the measurement (mid-point of the exposure);

C_o is the mean magnitude for the ensemble lightcurve data;

C_n and S_n are Fourier coefficients;

P is the rotation period;

t_o is the zero-point time chosen near the time span of the observations;

m is the degree of order of the fit.

Proposed software:

Petr Pravec's Asteroid Light Curve

Additional references:

Warner, B. 2006. A Practical Guide to Lightcurve Photometry and Analysis. Springer, 294 pps.

Harris, A. W. and Lupishko, D. F. 1989. Photometric Lightcurve Observations and Reduction Techniques. In 'Asteroids II', pp. 39-53.