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Modelling asteroids using lightcurve and adaptive-optics data with SAGE method.

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Abstract

We present the utilisation of genetic algorithm to create asteroid models from lightcurves and VLT/SPHERE adaptive-optics images. The lightcurve-only non-convex SAGE method [1] was extended to include disk-resolved data during the modelling, alongside lightcurves.

1. Data

The high angular resolution adaptive-optics images obtained by VLT/SPHERE (e.g. [2]) push the limits of ground-based observations of large asteroids (D>100km). Prior to that, detailed shape and local topography could only be studied via in-situ observations by space missions, which are scarce and costly. Even though adaptive-optics images contain a lot of information on shape and local topographic features, number of them and geometries at which they were obtained can be limited. Lightcurves of asteroids, on the other hand, are technically easier to obtain and usually cover many decades and apparitions of a single target. Lightcurves and adaptive-optics images can complement each other and, when used together during the modelling, can lead to models of better quality.

2. Method

We used the SAGE method [1] capable of generating non-convex shapes form lightcurve data. The method utilises genetic algorithm to minimise model's synthetic observations fit to the data. In each iteration a random population of shapes and spin states is generated. Their synthetic observations are then compared with observational data, and based on the fit the best model is chosen as the seed for the next generation of models.

The SAGE method was extended to handle adaptive-optics images. 2D images of shape models are generated for each adaptive-optics images epoch alongside synthetic lightcurves. Both datatypes are compared to the observations and the fit is then dynamically weighted. The comparison between synthetic and observed adaptive-optics images is performed using edge detection, as the differences in flux of the resolved body is less reliable than its silhouette.

3. Results

We will present the results of modelling for selected asteroids observed by ESO Large Program (ID: 199.C-0074; PI: P. Vernazza).

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