A new look at Europa’s photometry

Ines Belgacem, Frédéric Schmidt, & Grégory Jonniaux

GEOPS, Univ. Paris-Sud, CNRS, Université Paris-Saclay, 91405 Orsay, France. Airbus Defence & Space, Toulouse, France. *ines.belgacem@u-psud.fr

Introduction

The JUICE (JUpiter ICy moons Explorer) mission from ESA is to arrive in 2030 to study Jupiter and its icy moons [1]. To help the validation of its vision-based navigation algorithm [2], we have been taking a new look at Europa’s photometry.

Dataset

This work uses images from Voyager’s ISS cameras [3] and New Horizons’ LORRI [4].

Model

We use Hapke model defined in Hapke, 1993 [5]:

\[ r_{i,k} = (1 + \alpha_k) \times r_{i,Hapke} \]

\( \alpha_k \) is an image-dependent coeff. (k=image #) to account for errors in the calibration of the images.

Method

Step 1: Correct metadata, distortion & calibrate

Step 2: Project to world

Step 3: Inverse the problem [6,7]

Results

Figure 6 – Map of Europa by Jonsson [8] with the different regions of interest we arbitrarily defined for this study

Particle phase function parameters - Fig. 7

- values fall across the ‘Hockey stick’ line ([9], [10])
- \( b \) overall better constrained and describes a rather large lobe of diffusion for the most part
- most regions are backscattering \((c > 0.5)\) : consistent with global known photometric behavior of Europa ([11], [12])
- number of forward scattering ROIs adding to the one very forward scattering terrain identified by Domingue and Hapke, 1992 [13]
- ROI#9 is the most forward scattering and narrow

Macroscopic roughness \( \theta \) - Fig. 8

- no clear trend even if roughest areas are close to the equator
- no significant hemispherical difference
- higher \( \theta \) values than past studies [13, 14] that found a maximum of about 23°

The single scattering albedo is high with values above 0.85 at the exception of ROI#2 and ROI#13 with notably low values of about 0.7. The opposition effect parameters are not discussed here.

Future work

We would like to continue this work with:

- tests of more photometric models
- similar studies for Ganymede and Callisto
- extension to some Galileo images

Acknowledgements

This work is supported by Airbus Defence & Space, Toulouse (France) and by the “IDI 2016” project funded by the IDEX Paris-Saclay, ANR-11-IDEX-0003-02

References