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3D models of planetary bodies

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Abstract

Current technology allows us to print various object in 3D for teaching and education purposes, including for the visually disabled [1]. The use of 3D printer for planetary science has been perceived since the premises of this industrial revolution [2]. In parallel several services and web-services have been developed to help the users to create their own model [3]. We propose here a database of ready-to-use 3D model of planetary bodies at full scale.

1. Introduction

3D printing at school/university is nowadays not uncommon but is limited by the lack of files ready-to-use. Converting the NASA's Planetary Data System archived topography to triangulated mesh file is not obvious. In addition, since planetary bodies are ball-like, they require a large volume and are thus cost-full. We propose here an open source database of STL files, ready to print, usable for most of the printer of the market.

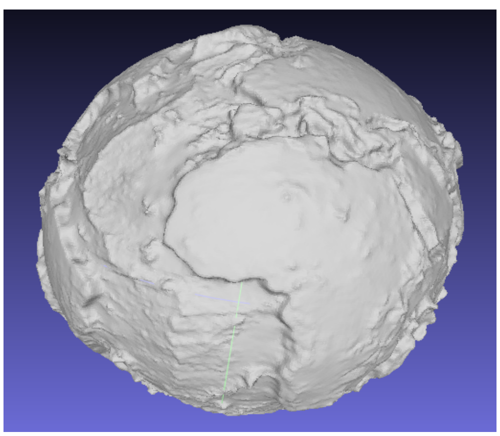

Figure 1: Earth's topograhy exaggerated

For pedagogical purpose, we propose two sets of data: (i) models scaled so that the Earth is 6 cm radius (the maximum allowed in our printer). This dataset can be very easily rescaled to your favorite printer; (ii) models with vertical exaggeration, such that they always fit into a 6 cm radius sphere, but with 1 cm radius variation dedicated to the topography (radius from 5 cm to 6 cm). Again this dataset can be very easily rescaled to your favorite printer but the exaggeration is fixed (16% of the printed object radius).
In order to facilitate the printing for 3D printer without "hole" printing capability, we also provide half planets' that users can easily stick together after printing.

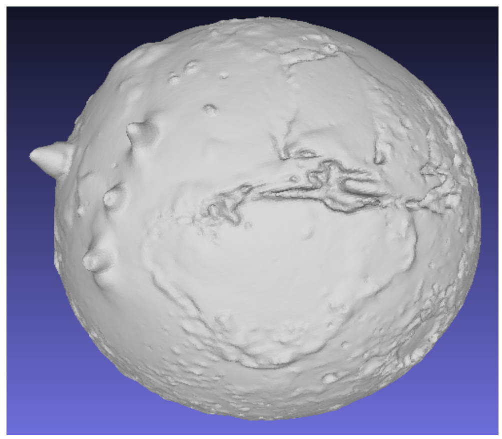

Figure 2: Mars' topography exaggerated

2. Method

We downloaded the maps of planetary datasets in the corresponding NASA's Planetary Data System archives. Then we generated XYZ point clouds at 0.5 degree resolution, with/without exaggeration (see table 1 and 2). Finally we computed a triangulated mesh and converted it into standard STL format (stereolithography). Figure 1 and 2 represents examples of Earth and Mars with topographic exaggeration. The last step consists in creating a inner sphere and an internal structure to ensure the mechanical resistance of the printed object (see figure 3).

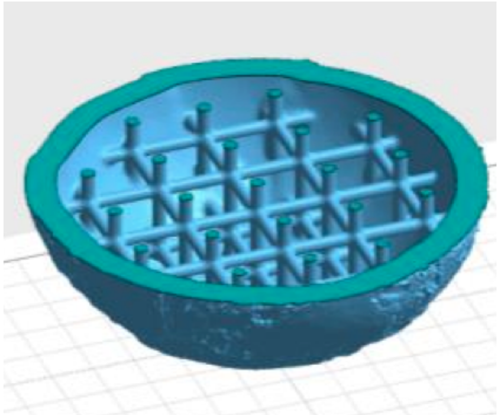

Figure 3: Internal structure, to ensure mechanical resistance but save printer matter and thus the cost.

Body	Topography exaggeration	Maximum Radius (cm)	Topography difference (cm)
Mercury	1	2.1	$8.0\ 10^{-3}$
Venus	1	5.2	$1.1\ 10^{-2}$
Earth	1	5.5	$1.3\ 10^{-2}$
Mars	1	2.9	$2.4\ 10^{-2}$
Moon	1	1.5	$1.5\ 10^{-2}$

Table 1: Summary of model parameters for scaled models

Body	Topography exaggeration	Maximum Radius (cm)	Topography difference (cm)
Mercury	48	6	1
Venus	86	6	1
Earth	79	6	1
Mars	21	6	1
Moon	17	6	1

Table 2: Summary of models parameters for exaggerated models

Figure 4: Printed Northern Earth hemisphere.

3. Results

We have performed several tests. Figure 3 represents the Northern hemisphere of the Earth as an example.

4. Conclusion and perspectives

Currently, the 3D models are available here: http://planeto.geol.u-psud.fr/spip.php?article328. A new website will be provided soon. We plan to propose the full sets of planetary bodies, including comets, asteroids and small bodies. We also included an example of putative exoplanet's topography [4].

References

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