SHAP7 version of the 67P/Churyumov-Gerasimenko nucleus shape model

The SPG versions of the dataset represent the shape models of the nucleus of

comet 67P/Churyumov-Gerasimenko as derived using stereo-photogrammetric

methods. Images obtained with the Narrow Angle Camera of the Optical,

Spectroscopic, and Infrared Remote Imaging System (OSIRIS) instrument were

used in constructing these models.

The shape models presented here were developed at DLR (Berlin, Germany) by

Frank Preusker and Frank Scholten using the stereo-photogrammetric (SPG)

technique. Details about the SPG technique as well as details about the full

reconstruction process of comet 67P/Churyumov-Gerasimenko from SPG techniques

can be found in Preusker et al., 'Shape model, reference system definition,

and cartographic mapping standards for comet 67P/Churyumov-Gerasimenko -

Stereo-photogrammetric analysis of Rosetta/OSIRIS image data' A&A 583, A33,

2015 [PREUSKERETAL2015].

Additional information about the nucleus of 67P can be found in Sierks et

al., 'On the nucleus structure and activity of comet

67P/Churyumov-Gerasimenko', Science 347, aaa1044, 2014 [SIERKSETAL2014].

SHAP7 version of the model

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The SHAP7 model represents the final version of the SPG shape models. It

has been derived from 1531 OSIRIS/NAC images acquired between 5 Aug 2014 and

13 Feb 2016 (see below). During this time frame, both, the northern and the

southern hemisphere, were illuminated in a way that the selected dataset allowed

for a global SPG processing and the derived SHAP7 model covers the entire surface

of 67P. The SHAP7 model is defined in the Cheops reference frame [PREUSKERETAL2015]

The original full resolution version of the SHAP7 model consists of ~44M facets.

It has an average lateral sampling distance of ~1-1.5 m. The derived reduced

resolution versions (4M, 2M, 500K, 125K, 50K facets) have larger sampling distances,

scaling inversely with the number of facets.

TABLE: Parameters of images used to reconstruct the SPG SHAP7 model.

 UTC date of first NAC image: 2014 AUG 05 23:19:14.571

 UTC date of last NAC image: 2016 FEB 13 19:07:40.736

 Number of NAC images: 1531

 Lowest image resolution: 5.2 m/pixel

 Highest image resolution: 0.15 m/pixel

 Typical image resolution: ~1 m/pixel

Reference Frame and Coordinate System

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The Cheops reference frame was defined using the SHAP4S shape model and has

been adopted for the standard for all other formats of the 67P shape model.

The orientation of the models in the J2000 Equatorial frame (EME2000) is

described in Scholten, F. et al., 'Reference Frames and Mapping Schemes of

Comet 67P/C-G' in the PDF document CHEOPS\_REF\_FRAME\_V1.PDF in the DOCUMENTS

directory.

The body's coordinate system was defined with the +Z axis in the direction of

the spin axis and the prime meridian (+X axis) is defined such that the

center of the large boulder named Cheops is at a longitude +142.35 degrees,

following the IAU definition presented in the document

CHEOPS\_REF\_FRAME\_V1.PDF. The +Y axis completes the right-hand coordinate

system. The body center is not exactly coincident with its center of gravity,

but the offset is within the uncertainties derived for the surface positions.

Data Formats

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The models are presented in the standard PDSSBN vertex/triangular plate

format (see PDSSBN\_PLATE\_SHAPE\_DEF.ASC in the documents directory) with

dimensions of km in cartesian coordinates. The files are presented with VRML

wrappers that allow the model to be displayed with existing VRML viewers that

are freely available (e.g. INSTANT PLAYER, OCTAGA, CORTONA, etc.).

In addition to the PDS formatted files, the models have also been converted

to DSK kernels that can be used with the SPICE utilities.

For the complex shape of 67P, spherical coordinates (lat/long/radius) result

in multiple values in some regions of the nucleus, so the model is not

presented in this form.

Model Resolutions

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The SPG SHAP7 model is provided in multiple resolutions, allowing calculations to

be optimized for a given problem when the highest resolution is not

needed. The highest resolution model has ~44M facets, with additional versions

degraded to resolutions with 4M, 2M, 500k, 125k and 50k facets. The reduction in

resolution was achieved using a quadratic edge-collapse decimation technique.

Information contained in the filenames:

CG\_DLR\_SPG\_SHAP7\_500K.WRL

^ ^ ^ ^ ^ ^---- File format (VRML, SPICE DSK)

| | | | |-------- Resolution (# triangular plates)

| | | |------------- Shape model generation SHAPXXX

| | |------------------ Production Technique (SPG)

| |----------------------- Site of model development

|--------------------------- Comet C-G

Details about the SPG SHAP7 files

CG\_DLR\_SPG\_SHAP7\_4M.WRL - 1999975 vertices forming 3999962 triang. plates

CG\_DLR\_SPG\_SHAP7\_2M.WRL - 999928 vertices forming 1999860 triang. plates

CG\_DLR\_SPG\_SHAP7\_500K.WRL - 249953 vertices forming 499902 triang. plates

CG\_DLR\_SPG\_SHAP7\_125K.WRL - 62471 vertices forming 124938 triang. plates

CG\_DLR\_SPG\_SHAP7\_50K.WRL - 24990 vertices forming 49976 triang. plates

TABLE: Shape Model Characteristics (for the SPG SHAP7 model)

 Surface Area: 51.7 km^2

 Volume: 18.56 +/- 0.02 km^3

 Mean diameter: 3.285 km (diameter of sphere of equivalent vol.)