SHAP4S 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].

SHAP4S Version of the model

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The SHAP4S model represents the current version of the SPG shape models. It

is developed from 218 OSIRIS/NAC images acquired between Aug 5 and Sep 3,

2014 (see below). During this time frame, the south pole region remained

unilluminated, and so there are regions in the shape model that are

unconstrained by observations. There are also a few small regions on the

northern hemisphere that are not well constrained (e.g. some overhangs).

These areas appear smooth in the model.

The SHAP4S model was used to define the Cheops reference frame and the Local

reference frames for the two lobes and the neck. It also revealed the 0.14

deg precession of the spin axis. [PREUSKERETAL2015]

The highest resolution version included here (4M facets) has an average

sampling distance of ~4 m. The reduced resolution versions have larger

sampling distances, scaling inversely with the number of facets.

TABLE: Parameters of images used to reconstruct the SPG SHAP4S model.

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

 UTC date of last NAC image: 2014 SEP 03 06:44:22.578

 Number of NAC images: 218

 Lowest image resolution: 2.4 m/pixel

 Highest image resolution: 0.9 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 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 4M facets, with additional versions

degraded to resolutions with 1M, 200k, 100k and 50k facets. The reduction is

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

Information contained in the filenames:

CG\_DLR\_SPG\_SHAP4S\_200K.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 SHAP4S files

CG\_DLR\_SPG\_SHAP4S\_4M.WRL - 1999974 vertices forming 3999958 triang. plates

CG\_DLR\_SPG\_SHAP4S\_1M.WRL - 499990 vertices forming 999992 triang. plates

CG\_DLR\_SPG\_SHAP4S\_200K.WRL - 99996 vertices forming 199998 triang. plates

CG\_DLR\_SPG\_SHAP4S\_100K.WRL - 49993 vertices forming 99990 triang. plates

CG\_DLR\_SPG\_SHAP4S\_050K.WRL - 24997 vertices forming 49994 triang. plates

TABLE: Shape Model Characteristics (for the SPG SHAP4S model)

 Surface Area: 48.1 km^2

 Volume: 18.7 +/- 1.2 km^3

 Mean diameter: 3.3 km (diameter of sphere of equivalent vol.)

 Axis orientation: RA: 69.54 +/- 0.35 deg

 Dec: +64.11 +/- 0.12 deg

 Precession cone angle: 0.14 deg

 Rotation Period: 12.4041 +/- 0.0001 hr (pre-perihelion)

 Precession period: 10.7 d