C-G Shape Model Review by NJB 29-JUN-2015
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Reviewer: Nat Bachman (JPL/NAIF)

These comments apply to the DSK files included in the data set

ro-c-osinac_osiwac-5-67p-shape-v1.0

provided for review by Dr. Ludmilla Kolokolova on 6-JUN-2015.

DSK file structure

All DSKs passed structural correctness checks. These checks rule out certain input errors that are not detectable by the DSK creation program MKDSK. The also verify correct processing by MKDSK.

Voxel grid parameters

A minor error was made in specifying the coarse voxel grid scale for some files: this scale should be an integer. When a non-zero fractional part is provided, the number is rounded to the nearest integer.

For the larger files, both the fine and coarse scales could be adjusted to improve ray-surface intercept computation speed. For example, for the file

cg_mspcd_shap2_001m_cart_dsk.bds

changing the fine scale to 2.5 and the coarse scale to 5 resulted in a speed-up of about 30 per cent according to one timing test. For the file

cg_spc_shap2_786k_cart_dsk.bds

changing the fine scale to 2.0 and the coarse scale to 5 resulted in a speed-up of about 25 per cent.

Surface topology

Tests were performed to assess whether the surfaces described by the DSK files had certain ``simple'' topological properties:

1. Does each edge belong to exactly two plates?

2. If condition (1) is met, are the orientations of the edge compatible: that is, are the common vertex orders opposite in the two plates?

3. Does the surface have a well-defined interior and exterior?
This was addressed by a heuristic check: for each plate, points were selected 0.1mm above and below the plate's centroid (``above'' is defined as the outward normal direction). A consistency check was made for each point to verify that the point is outside the region bounded by the surface or inside it, as appropriate.

Results are shown below:

SPC DSK	orientation	#plates sharing	interior/exterior check	edge check
6K	passed	passed	passed	
12K	passed	passed	passed	
24K	passed	passed	passed	
47K	passed	passed	passed	
96K	passed	FAILED	FAILED	
195K	passed	FAILED	FAILED	
399K	passed	FAILED	FAILED	
786K	passed	passed	FAILED	

MSPCD DSK	orientation	#plates sharing	interior/exterior check	edge check
6K	passed	passed	passed	
12K	passed	passed	passed	
24K	passed	passed	passed	
48K	passed	passed	passed	
98K	passed	passed	passed	
191K	passed	passed	passed	
391K	passed	passed	passed	
760K	passed	passed	passed	
1M	passed	passed	FAILED	

In all of the the cases where there were more than two plates sharing an edge, there were 4 or 6 plates sharing that edge.

Failure of the interior/exterior check can be caused by plates that have non-trivial intersection: one plate intersects the interior of another. See the attached image for an example (this example is NOT from the set of DSKs under review).

Failure for a given shape suggests that the shape is not homeomorphic to a sphere. While there appears to be no requirement that the shape models have this property, having it might be helpful both for map-making and certain kinds of computations, such as creation of a simple inner bounding surface for the the shape.

Cautionary note: the code used for the interior-exterior test is not yet well tested itself. In addition, the criterion for determining that a point is ``inside'' the region bounded by the surface is not bullet-proof: given a valid surface, it can still fail in some very rare instances.

Time coverage

Is 2099 the best choice for the coverage end time for these models? Is there a plan to create updated models, and if so, should the end time for the current set match the start time of the new set?

Reference frame

Should the models use the PCK or CK-based body-fixed reference frame?

Comment area

The DSKs comment areas contain only the comments automatically inserted by MKDSK. It may be useful to insert more complete documentation into the comment area.