Radar scattering functions using Itokawa as ground truth

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Determining shape models from radar and lightcurve data is an inverse problem that involves computing the expected radar image that would result from a given shape and viewing geometry. The original work of Hudson [1] used models of radar scattering derived from observations of the terrestrial planets. Hudson verified his results using a laboratory simulation of delay-Doppler imaging. Here we compare radar data to synthetic data using the Hayabusa-derived shape model of Itokawa [2] to model Arecibo and Goldstone radar images [3,4].

The synthetic images match the observations well (see figure), but sometimes have bright pixels on the leading edge (top) of the data that are not seen in the synthetic images. We model the scattering dependence on incidence angle as a function tabulated every 0.1 degrees of incidence angle. The resulting fit is a good match to a $\cos^n \theta$ distribution, but with a strong spike near (but not exactly at) zero incidence. We are studying the details of the low-angle scattering.

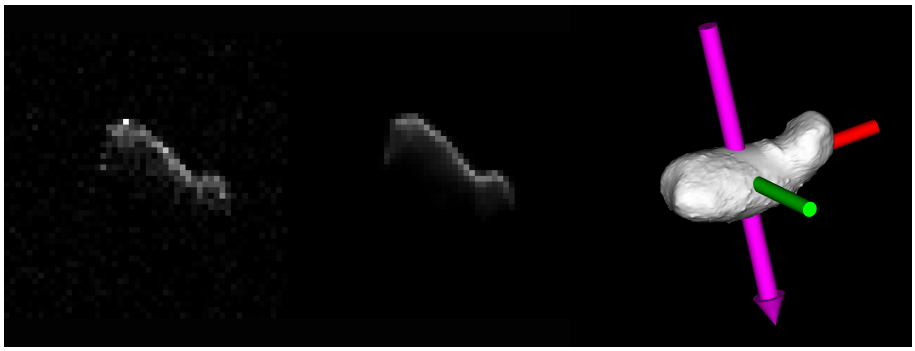

Figure: Figure shows a typical radar image (left), a synthetic radar image based on the Hayabusa-derived shape model (center), and the model as it would be viewed from the direction of the radar (right). Note that the shape matches very well, but there are bright pixels in the data not seen in the model, possibly due to glints off of surfaces not resolved in the version of the shape model we used.

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