A proposal for planetary regional exploration using passive seismics

Extensive geophysical surveying has been done on planetary missions in the past, however most of it was performed on a global scale. The results of the latest exploration missions have raised a demand for regional (non-global) seismic exploration of the first few kilometers of the subsurface. For example, with such seismic information we could evaluate the history of sedimentary processes on Mars or Titan, image the base of basaltic flows on the Moon, detect buried impact craters, or find a boundary between ice and water on moon Europa.
For regional seismic exploration a dense network of sensors is necessary, contrary to only a few sophisticated seismological broad-band stations that are sufficient for global exploration. In exploration for oil and gas on Earth the industry conventionally uses many relatively simple sensors that are planted onto the surface by workers, and many charges of explosive sources to generate the image of the subsurface.
To perform regional seismic exploration on other planets, we propose to deploy a dense network of miniature sensors ejected by an orbiter over an area of a few square kilometers, and to generate the image of the subsurface *without the use of active sources* ("passive seismics"). This technique is called seismic interferometry and uses cross-correlation of noise recordings to reconstruct the reflection signal. The main challenges in this project are the miniaturization of the sensors to a size small enough for thousands of them to be carried as payload, the coupling of the sensors to the surface without planting, and compensation for the irregular distribution of the sensors over the surface.

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