Investigation of Lunar Near-Surface Structure via Seismic Wave Propagation Simulation

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Exploration of the near-surface structure of the Moon is of great importance for understanding the surface degradation process and for illustrating past geological activities (e.g., tectonics, volcanism). In addition, in the context of future manned missions on the Moon, it is essential to know the subsurface properties for building a safe base.

As conducted on Earth, seismic exploration is a powerful way to realize the above objectives. In fact, such an experiment was performed during the Apollo lunar seismic observations (1969 - 1977). For example, Cooper et al. (1974) analyzed the Apollo 14 and 16 Active Seismic Experiment (ASE) and the Apollo 17 Lunar Seismic Profiling Experiment (LSPE) data, where astronauts generated artificial ground motions with thumper rod, grenades, and explosive packages. That gave the first subsurface structure model. Later, Nakamura (1976) investigated the Apollo 15 and 16 Passive Seismic Experiment (PSE) data recorded during a rover moving and estimated the near-surface diffusivity. More recently, Tanimoto et al. (2008) applied a noise correlation approach to the Apollo 17 LPSE data and updated the 1-D velocity structure at the Apollo 17 landing site.

While all these works paved the way to elucidating the subsurface structure of the Moon, I recently found some discrepancies between the existing models and the expected waveforms from wave propagation simulations. In the presentation, followed by the introduction of the observed discrepancies, I will discuss how the simulation can be improved. After that, I will describe how the obtained knowledge is applied for future lunar seismic explorations.

References:
•Cooper et al. (1974), Lunar near-surface structure, *Rev. Geophys. Space Phys.*, 12, 3, 291-308.
•Nakamura (1976), Seismic energy transmission in the lunar surface zone determined from signals generated by movement of lunar rovers, BSSA, 66, 2, 593-606.
•Tanimoto et al. (2008), The noise cross-correlation approach for Apollo 17 LSPE data: Diurnal change in seismic parameters in shallow lunar crust, JGR, 113, E08011.

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