Geophysical Research Abstracts
Vol. 21, EGU2019-7504, 2019
EGU General Assembly 2019

LVL transfer function and ground/duricrust mechanical properties predicted from InSight SEIS data on the ground

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Both seismic sensors of the SEIS (Seismic Experiment for Interior Structure) instrument (Lognonné et al. 2019) of the NASA InSight mission, i.e. the VBBs (Very Broad Band seismometers) and SPs (Short Period seismometers), are mounted on a mechanical leveling system, the LVL. Its purpose is first to provide the mechanical coupling between the instrument and the ground and then to ensure the sensors' level placement on the Martian ground. We developed a simplified analytical model of the LVL (Bagaini and Barajas-Olalde 2007, Fayon et al. 2019) in order to reproduce its mechanical behavior by predicting its resonances and transfer function. After calculation of the modeled LVL modes, two resonances were obtained between 35 and 50 Hz in both horizontal components, which is in good agreement with laboratory measurements performed on the LVL flight model. As these frequencies are comprised in the seismic measurements bandwidth, their study is crucial. A few parameters are adjustable in the model and after some simulations we noticed that the horizontal ground stiffness and the torque induced by the ground on the LVL's feet seem to change these both horizontal mode frequencies. This means that the LVL resonances depend on the mechanical coupling between it and the ground. For this reason, this resonances, as well as the relative comparison between SPs and VBBs signals, can be used to assess both the ground structure just beneath the feet and the quality of the transfer function. Whereas the InSight lander contact with the ground has been imaged by the lander cameras (Maki et al. 2019), this has not been possible for the contact of the SEIS feet, which remains to be characterized by indirect methods. We show the preliminary analysis of SEIS data on the ground as well as some results from updated SEIS models and discuss constraints on the depth of penetration of the cone on each foot, and on the geometry of feet penetration. We conclude by discussing if the mechanical properties of the surface layer or duricrust can be inferred.