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Preliminary Assessment of Insight Landing Site Seismic Noise and Comparison to Models

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The InSight spacecraft [1] , launched from the West Coast Vanderberg base May 5th 2018, has landed successfully on Mars on November 26th 2018. Its main science objective is to constraint the Mars internal structure by measuring the seismic activity on various bandwidth : very low frequency (tides around 10-5 Hz), in the main seismic bandwidth (from 0.01 Hz to 1 Hz) and above, from 1 Hz to 100 Hz In order to achieve this, SEIS [2] consists of two independent, 3-axis seismometers: an ultra-sensitive very broad band (VBB) oblique seismometer; and a miniature, short-period (SP) seismometer which provides partial measurement redundancy and extends the high-frequency measurement capability. VBB, SP, and the leveling system are deployed on the ground as an integrated package. They are isolated from outside temperature variations by a CO_2 thermal insulating layer and the WTS (wind and thermal shield) and are connected by a flexible cable tether to E-box, a set of electronic cards located inside the Lander thermal enclosure. Simultaneous measurements of pressure, temperature, and wind by the APSS sensors support SEIS analyses.

In addition to its self noise, seismic measurements are impacted by the instrument sensitivity to the environment .The daily variations of temperature, magnetic field , atmospheric pressure impact the background noise may hinder the detection of mars quakes. Therefore, in various papers [3],[4],[5] we have built a comprehensive model of the instrument noise to help us understand the performance of the instrument in its environment, and to help us derive the overall mission performance. This model will be compared to actual measurements on Mars.

The noise model of the instrument has been thoroughly validated. However, we expect (hopefully!) some surprises on Mars. We will compare the noise model vs the reality in the various configurations measured so far: when SEIS is on the deck, when SEIS is deployed without WTS and in its final configuration. Preliminary results are more than encouraging, and we will present the latest noise estimates together with the predictions.

Evaluation of sizing parameters
One of the first outcomes of the model analysis is that some parameters have first order impact on the overall instrument performance; the most important is for instance the ground compliance. We will review these key parameters and preliminary estimates of their value through the analysis of the seismic measurements [6]

[1] Banerdt. 2013 No. 1719, p.1915
[2] Lognonné.et al (in press) Space Sci. Rev
[3] Mimoun, D. et al. (2017) Space Sci. Rev. 211: 383.
[4] Murdoch, N. et al. (2017) Space Sci. Rev. 211: 457
[5] Murdoch al. Space Sci Rev (2017) 211: 429.
[6] Murdoch, et al. Space Sci Rev (2018) 214: 117.