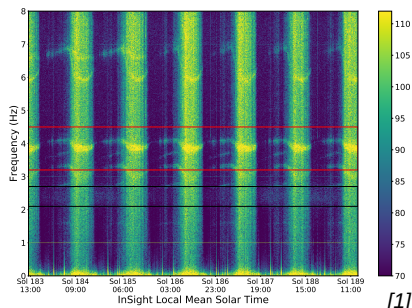


Autocorrelation of the ground vibration recorded by the SEIS-InSight seismometer on Mars for imaging and monitoring applications

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Context of the NASA InSight mission

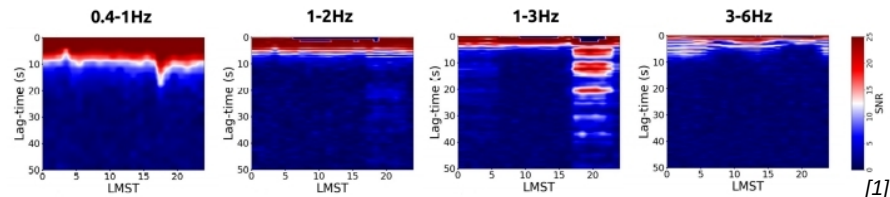
Since early February 2019, the SEIS seismometer deployed at the surface of Mars in the framework of the NASA-InSight mission has been continuously recording the ground motion at Elysium Planitia ([2]). The background signal recorded by SEIS is mainly driven by changes in the speed and turbulent flow of the wind induced by sunlight variations ([3]). The wind also excites the resonance modes of the InSight lander whose central frequency exhibits a daily modulation induced by temperature variations. These lander modes are significant barrier to the use of seismic interferometry technique.



[1]

Autocorrelation computation and SNR analysis

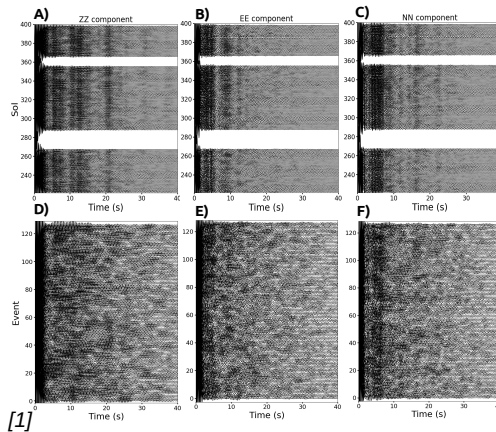
We compute, for each Sol (martian day) and each local hour (LMST), all the components of the time-domain autocorrelation tensor of random ambient vibrations in various frequency bands. We perform a signal-to-noise (SNR) analysis ([4]) on the hourly ACFs along the martian days to check the stability and the reliability of the potential seismic arrivals in each frequency band. These analyses suggest that the reconstructed ground responses are most reliable **during the evening (18h-23h LMST) in the 1-3Hz frequency band**, where an amplification of both ambient vibrations and seismic events is observed around 2.4Hz ([5]).



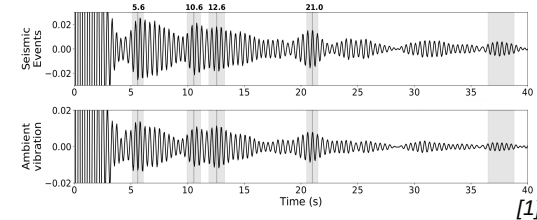
[1]

Imaging application

The average Auto-Correlation Functions (ACFs) from **both ambient vibrations and seismic events** in the 1-3Hz frequency band contain well identifiable seismic arrivals up to 30 seconds, that are very consistent between the two datasets. We interpret the vertical and horizontal ACFs as the ground reflection response below InSight for the compressional waves and the shear waves respectively.



[1]



[1]

Monitoring application and futur works

A stretching analysis reveals that the ACFs in the 1-3Hz band are **extremely stable** over the study period (Sol 180 to Sol 400) suggesting that the observed wavefield sees no variation in apparent velocity. Nevertheless we measured relative travel-time changes in the coda of high-frequency seismic multiplets (identified by [6]) in the **5-9Hz** frequency band suggesting a seasonal variation of the physical properties of the near surface. In future works we will analyze the high-frequency ACFs in order to extend this observation to the full martian year.

