

Analysis of radio-occultation data from Mars Express

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Abstract

ESA's Mars Express (MEX) spacecraft has been exploring the red planet since January 2004. The spacecraft is able to receive and transmit signals at both S-band and X-band. Changes in the radio signals while going through the atmosphere can yield information on the refractivity, temperature pressure, and density of the neutral atmosphere, as well as the electron density in the ionosphere. More than 700 radio occultations have been performed by Mars Express so far (Paetzold et al., 2016). This rich data set is still largely unexploited, in particular the corresponding ionospheric profiles. The available data – residual Doppler signals – are complex to process into higher-level scientific products such as atmospheric profiles. No software for this processing is publicly available. Therefore, it was decided to develop a data processing pipeline in Python that converts the archived calibrated Doppler data into atmospheric profiles.

We explain the algorithm in detail, show the measured refractivity profile (Figure 1), and a few processed profiles of electron (Figure 2) and neutral densities. These are compared with results obtained from other groups and the samples profiles published by MaRS (<http://pds-geosciences.wustl.edu/mex/mex-m-mrs-5-occ-v2.0/>). Once fully validated, we plan to release the data set to the scientific community.

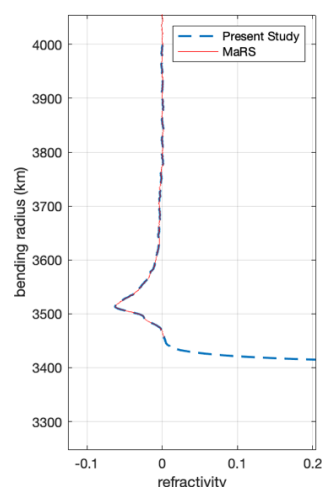


Figure 1: Refractivity profile –18 May 2004

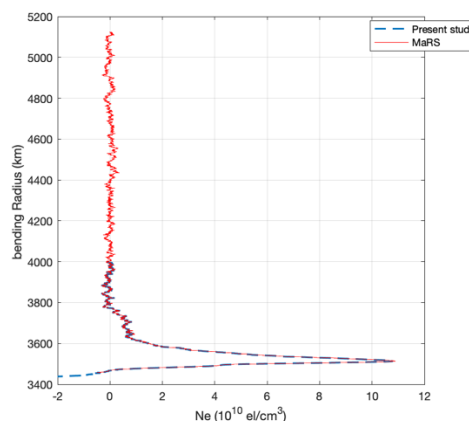


Figure 2: Electron density profile - 18 May 2004

Reference:

Paetzold, M. et al., Mars Express 10 years at Mars: Observations by the Mars Express Radio Science Experiment (MaRS), Planetary and Space Science, Volume 127, p. 44-90, 2016