EGU21-12816
https://doi.org/10.5194/egusphere-egu21-12816
EGU General Assembly 2021

Analysis of radio occultation data to determine atmospheric profiles and associated uncertainties

Flavio Petricca, Gael Cascioli, and Antonio Genova
Department of Mechanical and Aerospace Engineering, Sapienza University of Rome, Rome, Italy
(flavio.petricca@uniroma1.it)

The analysis of atmospheric radio occultations enables an in-depth investigation of planetary ionosphere and neutral atmospheres, by measuring the radio frequency shift that affects a signal propagating through the medium. A precise characterization of the atmospheric layers requires a thorough processing of the radio tracking data to estimate the thermodynamic properties of the atmosphere and their related uncertainties.

A standard procedure to process radio occultation data requires a preliminary knowledge of the spacecraft trajectory. In this work, we present a technique to retrieve refractivity, density, pressure, and temperature profiles with their associated uncertainties through the analysis of raw radio tracking data occulted by the atmosphere. By integrating the algorithm for radio occultation processing with a Precise Orbit Determination (POD) software, an enhanced reconstruction of the spacecraft trajectory is obtained to recover the frequency shift due to the medium refraction. The resulting radio signal is then processed to yield information regarding atmospheric properties. A Monte Carlo simulation algorithm is also included to provide the formal uncertainties of the estimated parameters.

We applied this technique to radio occultation profiles of the NASA mission Mars Reconnaissance Orbiter (MRO). To validate the method, our estimated atmospheric profiles are compared to the numerical predictions of the Mars Global Reference Atmospheric Model (GRAM) and the Mars Climate Database (MCD).