EPSC Abstracts
Vol. 13, EPSC-DPS2019-1832-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Radio Occultations Using CubeSats to probe the planetary atmospheres

Ahmed El Fadhel (1), Ozgur Karatekin (1) Olivier Witasse (2) Sami Asmar (3) Bart Van Hove (1) Nicolas Begeot (1)

(1) Royal Observatory of Belgium, Brussels, Belgium (ahmed.elfadhel@hotmail.com)

(2) Scientific support office, European Space Agency, ESTEC, Noordwijk, Netherlands

(3) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA

Abstract

Radio waves are used to transmit scientific data from Martian orbiters, rovers, and surface platforms to ground stations on Earth. As the waves travel through the atmosphere, they are perturbed by the neutral part at lower altitudes and the ionosphere at higher altitudes. Radio Occultation (RO) experiments are conducted by extracting Doppler frequency changes from the received radio signal, caused by passing through different atmospheric layers on Mars. This allows to resolve the atmospheric structure in terms of density, pressure, and temperature. RO is a common measurement technique used to sound planetary atmospheres, as well as that on Earth [1].

RO experiments on Mars typically involves an orbiter that transmits directly to Earth (see figure 1). Given the known position and velocity of the orbiter relative to the ground station on Earth, the Doppler frequency contains information on the bending angle caused by the Martian atmosphere, which can be related to atmosphere density via the refractivity. Uncertainties that influence this process include navigation errors, the influence of the Earth atmosphere, and interplanetary plasma. Advantages of RO are its altitude resolution and accuracy compared to other remote sensing methods.

In this study, we investigate possible radio occultation experiments between two CubeSats, both orbiting Mars or Venus. It has been shown that, having two or more orbiters, significant improvements in spatial and temporal coverage of the atmospheric profiles can be obtained, compared to RO performed by an orbiter and a ground station located on Earth [2,3].

We investigate the mission feasibility depending on several driving parameters such as the number of cubesats, the orbits, the technical complexity, the mission lifetime, and the cost.

1. Figures

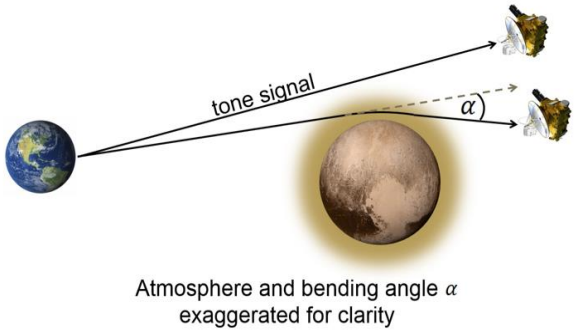

Figure 1: Illustration of the Radio Occultation method to sound the Martian atmosphere.

References

[1] Author, A., Author, B., and Author, C.: First example of a cited article title, First Example Journal, Vol. 1, pp. 1-100, 1999.

[1] Fjeldbo, G. and Eshleman, V. R.: *J. Geophys. Res., 70(13)*, 3217–3225, 1965.

[2] Asmar et al. : *IEEE, 2016.*

[3] Williamson, W.; Mannucci, A. J. and Ao, C. : *LCPM-12*, 2017