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GUIDANCE AND MISSION PROGRAMMING OF MACROMEGA INSTRUMENT FOR EXPLORATION OF MARS AND ITS MOONS

Abstract

MacrOmega is part of the French contribution to the Martian Moons eXploration (MMX) mission, planned to be launched in 2024 by the Japan Aerospace Exploration Agency (JAXA). It is a near infrared spectrometer made by the French Aerospace Institute (IAS) of Orsay that will provide crucial information to determine the origin of Phobos and Deimos. In addition to analysing the required observation trajectories, CNES is in charge of supplying guidance laws and mission programming strategies that optimise the use of MacrOmega. Experience from high resolution Earth observation missions like Pleiades is a major asset as we already have a good understanding of the main steps and stakes related to mission programming: splitting the target observation zone in unitary elements, determining for each of the latter the observation time slots and the associated performances, elaborating an acquisition plan that considers time constraints and priority strategy. Eventually a mission programming plan respecting all system and instruments constraints is built, including instrument line of sight guidance profiles that fulfil image quality requirements. MMX mission brings new challenges. Flexibility is a major driver as by definition an exploration mission is dedicated to unveil the unknown: mission programming strategies have to fulfill the main objective of obtaining highest covered surface at best resolution while allowing the scientific team to add in short loop high priority observation requests. Image resolution will vary significantly between observations, actual shape of Phobos and Deimos will be refined during the mission thanks to the other instruments and specific trajectories around Phobos and Deimos induce an important evolution of distance and velocity with respect to the observed sites: efficient guidance laws for the line of sight are required to guarantee image quality as well as elaborated mission programming strategies to optimise performances. Sharing between instruments of observation time and satellite critical resources (energy, data download and commands upload) will evolve during mission phases: close interaction with the System is crucial in order to improve scientific return. To address those challenges, with dedicated analysis tools we determine best achievable performances and evaluate strategies and guidance laws. When they are robust they are implemented in a Guidance and Mission Programming simulator that generates realistic guidance profiles and mission programming plans which can be analysed with the 3D VTS tool. Eventually we apply a user orientated approach to improve our understanding of the scientific needs and assess solutions through realistic use cases.