Mars Exploration (3)
Mars Exploration (2) (2)

Author: Mr. Eric Sawyer
Centre National d'Etudes Spatiales (CNES), France

Prof. Maria Antonietta Barucci
LIRA, Paris Observatory-PSL, France
Dr. Francis Rocard
Centre National d'Etudes Spatiales (CNES), France
Prof. Sonia Fornasier
LIRA, Paris Observatory-PSL, France
Dr. Alain Doressoundiram
LIRA, Paris Observatory-PSL, France
Ms. Véronique Tyrou
Centre National d'Etudes Spatiales (CNES), France
Ms. Pernelle Bernardi
LIRA, Paris Observatory-PSL, France
Prof. Tomoki Nakamura
Tohoku University, Japan
Prof. Hiromu Nakagawa
Tohoku University, Japan
Dr. Takahiro Iwata
Japan Aerospace Exploration Agency (JAXA), Japan
Mr. Michel Le Du
Centre National d'Etudes Spatiales (CNES), France
Mr. Jean-Michel Rees
LIRA, Paris Observatory-PSL, France
Mr. Maxime Astruc
THALES Services, France
Mr. Sébastien Goulet
CS GROUP, France
Mr. Vincent Martin
Centre National d'Etudes Spatiales (CNES), France
Dr. Renaud Binet
Centre National d'Etudes Spatiales (CNES), France
Dr. Elisabet Canalias
Centre National d'Etudes Spatiales (CNES), France
Ms. Laurence Lorda
Centre National d'Etudes Spatiales (CNES), France

GUIDANCE AND MISSION PROGRAMMING OF MMX INFRARED SPECTROMETER (MIRS) FOR THE EXPLORATION OF MARS AND ITS MOONS

Abstract

MIRS 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 Laboratory of Space Studies and Astrophysics Instrumentation (LESIA) from Paris Observatory that will provide crucial information to determine the origin of Phobos and Deimos. CNES is in charge of supplying guidance laws and mission programming strategies that optimise the use of MIRS. Experience from high resolution Earth observation missions 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 into unitary elements, determining for each of the latter the observation time slots and the associated performance, elaborating an acquisition plan that considers time constraints and priority strategy. Finally, 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 fulfil the main objective of obtaining the highest covered surface at the best resolution while allowing the scientific team to add in short-loop high-priority observation requests. Image resolution will vary significantly between observations, the actual shapes 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 elaborate 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 these challenges, we use dedicated analysis tools to determine the best achievable performance and to evaluate strategies and guidance laws. Once these have been made 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. Finally, we apply a user-orientated approach to improve our understanding of the scientific needs and assess solutions through realistic use cases.