IAF SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 1) (4A)

Author: Mr. Eric Sawyer
Centre National d'Etudes Spatiales (CNES), France, eric.sawyer@cnes.fr

Prof. Maria Antonietta Barucci
LESIA - Observatoire de Paris, France, Antonella.Barucci@obspm.fr
Dr. Francis Rocard
Centre National d'Etudes Spatiales (CNES), France, francis.rocard@cnes.fr
Prof. Sonia Fornasier
LESIA - Observatoire de Paris, France, sonia.fornasier@obspm.fr
Dr. Alain Doressoundiram
Observatoire de Paris, France, alain.doressoundiram@obspm.fr
Mrs. Veronique Tyrou
Centre National d'Etudes Spatiales (CNES), France, veronique.tyrou@cnes.fr
Mrs. Pernelle Bernardi
LESIA - Observatoire de Paris, France, pernelle.bernardi@obspm.fr
Prof. Tomoki Nakamura
Tohoku University, Japan, tomoki@m.tohoku.ac.jp
Prof. Hiromu Nakagawa
Tohoku University, Japan, hnakagawa@tohoku.ac.jp
Prof. Takahiro Iwata
Japan Aerospace Exploration Agency (JAXA), Japan, iwata.takahiro@jaxa.jp
Mr. Michel Le Du
Centre National d'Etudes Spatiales (CNES), France, michel.ledu@cnes.fr
Dr. Jean-Michel Rees
LESIA - Observatoire de Paris, France, jean-michel.reess@obspm.fr
Dr. Laurent Jorda
Laboratoire d'Astrophysique de Marseille, France, laurent.jorda@lam.fr
Mr. Nicolas Théret
Centre National d'Etudes Spatiales (CNES), France, nicolas.theret@cnes.fr
Mrs. Nathalie Pons
Centre National d'Etudes Spatiales (CNES), France, nathalie.pons@cnes.fr
Mr. Christophe Donny
Centre National d'Etudes Spatiales (CNES), France, christophe.donny@cnes.fr
Mr. Sébastien Goulet
CS-SI, France, sebastien.goulet@cnes.fr
Mrs. Inês De Jesus Martins Carriço
Centre National d'Etudes Spatiales (CNES), France, InesFilipa.DeJesusMartinsCarrico@cnes.fr
Dr. Elisabet Canalias
CNES, France, elisabet.canalias@cnes.fr

DEVELOPMENT OF OBSERVATION STRATEGIES FROM MISSION DESIGN TO OPERATIONS – ILLUSTRATION WITH MARS MOONS EXPLORER INFRARED SPECTROMETER (MIRS)

Abstract

MIRS is part of the French contribution to the Martian Moons eXploration (MMX) mission that will be launched in 2024 by the Japan Aerospace Exploration Agency (JAXA). It is a near-infrared imaging spectrometer developed by the French Laboratory of Space Studies and Astrophysics Instrumentation (LESIA), of the Observatoire de Paris – PSL (Paris Sciences et Lettres), with close cooperation and financial support from CNES. One of the major mission goals is to understand the origin of Phobos and Deimos, providing important insights into planetary formation and the transfer of matter in the region connecting the inner and outer solar system.

During the four years of the mission, the MIRS control centre will provide precise sequencing of MIRS activities and guidance of its line of sight, with two main drivers: optimize scientific return and comply with the operability constraints of the instrument, the satellite and the system. In this perspective, observation strategies are designed, modelled and tested iteratively throughout all preparation phases of the mission. This agile approach is particularly adapted to MMX's ambitious, international, and multi-objective exploration mission: discussions on concrete simulation results and illustrations improves mutual understanding, raises unexpressed needs and constraints and promotes feedback on the efficiency of the proposed strategies. It also favours a global optimisation of the entire system by encouraging the refinement of the trajectories, the duration and priorities of the phases, as well as placing focus on the opportunities and difficulties inherent to the seasons of the Mars system.

The development of the strategy for a given phase consists of the following steps: 1) Definition of observation objectives, priorities and observation conditions, 2) Identification of slots available for observations, 3) Development of an observation selection and insertion algorithm which meets the needs, constraints and priorities, 4) Production of observation plans and related outputs, and 5) Performance analysis and feedback. To achieve this, mission simulators are a major resource as they provide a means to quickly implement algorithms and generate synthetic outputs: observation plans, plots, chronograms, coverage maps and 3D movies of the MMX and MIRS line of sight. Consolidated and approved strategies can subsequently be implemented into the operational libraries.

This paper describes the whole process of observation strategies development in cooperation with the MMX and MIRS system and scientific teams, as well as the current status and results.