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RLS FM performance characterization and calibration campaign with the Instrument Data Analysis Tool (IDAT)

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Abstract

The Flight Model (FM) of the RLS instrument for the ExoMars 2020 rover mission has been subject to a thorough campaign before delivery to ESA in order to properly characterize its performances. The Instrument Data Analysis Tool (IDAT) and SpectPro software tools have been key for the acquisition and interpretation of the data from the instrument. The results of the work performed with these tools during the RLS FM performance characterization and calibration campaign is presented here.

1. Introduction

The ExoMars 2020 rover mission will carry a drill able to obtain samples up to 2 meters depth under the Martian surface. It also features a suite of instruments (Pasteur Payload) inside the Rover's Analytical Laboratory Drawer (ALD) dedicated to exobiology and geochemistry research at the mineral grain scale after these samples have been crushed and powdered. The Raman Laser Spectrometer (RLS) is one of these key instruments [1]. The main ExoMars 2020 mission scientific objective is "Searching for evidence of past and present life on Mars". The RLS will contribute to this scientific goal through the precise identification of the mineral phases and the capability to detect organics on the powdered samples.

The on-ground characterization of the RLS FM is of utmost importance to guarantee the accuracy of the data received from the operation on Mars. During the RLS FM performance characterization campaign, several representative samples were analyzed, both in ambient and representative operational temperatures, including NIST standards, calibration lamps, the RLS Calibration Target and mineral powdered samples. These samples have allowed the performance

characterization of the instrument, including spectral response characteristics to allow for intensity and wavelength characterization. In addition, the analysis of representative samples has allowed the proper parameterization of the instrument acquisition algorithms [2] for its automated onboard operation.

2. IDAT/SpectPro

The Instrument Data Analysis Tool (IDAT) for the RLS instrument is a software tool that is used for the reception, decodification, calibration and verification of the telemetries generated by the RLS instrument, including both science and housekeeping (HK) data, as shown in Figs. 1&2. This allows the verification of the instrument status and the reception and interpretation of science data in a very user-friendly and fast way. The use of this tool is necessary during the system development phase of the instrument to provide a fast means for the decompression and interpretation of data in a fast and friendly way, saving a lot of data treatment time during the always-tight schedule on this development phase.
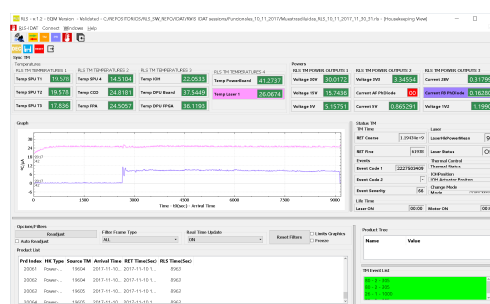

Figure 1: IDAT housekeeping view. This window allows monitoring the HK telemetry from the instrument in real time
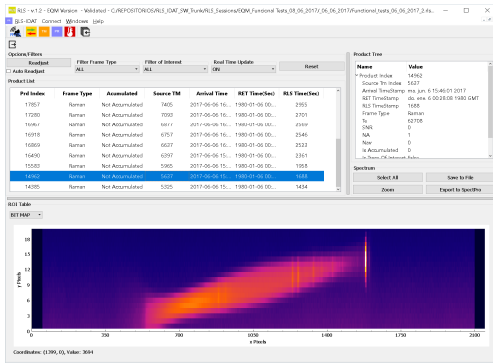
Figure 2: IDAT science product view. This window receives and shows all science products received from the instrument in real time
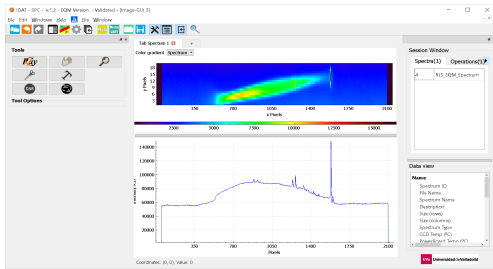

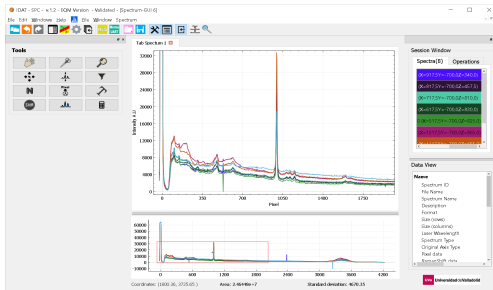Figure 3: SpectPro image spectra view. This window allows operation on image spectra.

Figure 4: SpectPro linear spectra view. This window allows operation on linear spectra using the available tool palette on the left.

IDAT also incorporates SpectPro, a comprehensive spectra analysis tool for the interpretation and analysis of the science data with tools and operations for both images and binned spectra. This tool includes all types of spectra analysis tools to operate both images (Fig. 3) and linear spectra (Fig. 4), and to perform all kind of operations such as binning, SNR calculation, baseline removal, cosmic ray removal, filtering, cutting, band adjustment, and it even features a spectra calculator to allow operations with spectra in a very simple and reliable way.

3. Summary and Conclusions

The development of the appropriate software tools for the analysis of instrument spectra in early stages of development is not only useful but necessary in order to save time during the development phase of the instrument, but also for helping to understand the instrument behavior and performances. In addition, these tools will be further used during the operation of the instrument. For RLS, the development of IDAT and SpectPro has allowed the characterization of the FM of the instrument during the scientific campaign, which will be shown during the conference.

References

[1] Rull et al., Astrobiology, 2017, 17, 627-654.

[2] Lopez-Reyes, G. and F. Rull Pérez (2017). "A method for the automated Raman spectra acquisition." Journal of Raman Spectroscopy 48(11): 1654-1664.