THE INTA RLS GROUND-TESTING FRAMEWORK: A VERSATILE SYSTEM TO VALIDATE THE ON-BOARD SOFTWARE AND SUPPORT THE INSTRUMENT FUNCTIONAL INTEGRATION

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Abstract

The Raman Laser Spectrometer (RLS) [1] is one of the Pasteur Payload instruments belonging to the analytical suite of the ExoMars2020´s Rover Module that will perform Raman spectroscopy on the Mars surface and subsurface samples in the search for biological traces.

As part of the RLS instrument development, a ground-testing framework has been implemented to emulate the electrical and logical behaviour of the Rover´s On-Board Computer (OBC), from low-level physical signals to complex commanding sequences, allowing the complete validation of the RLS on-board software against the system specification and the simulation of the real operations.

The RLS testing framework is able to fully command all Raman functionalities on ground, allowing the definition of high-level activity plans, built as a sequence of tasks and actions, and translating them into the final sequence of Rover OBC telecommands.

The system allows all the data generated during the testing campaigns to be checked in real-time against expected results, generating automated reports and notifying alarms and warning events to test operators in case of any detected anomaly. It also provides capabilities to post-process and evaluate the housekeeping and science telemetries.

The presented testing framework provided an essential support to the system engineering and AIV activities during the functional integration and performance verification of the different RLS units.

1. Introduction

Testing is needed in order to build the system right. Nevertheless, testing increases costs and delays the project schedule. Thus, automated testing gets special importance so that cost and time can be reduced in the same way as the quality increases. Automated testing in AIT phases brings many benefits: testing efficiency, faster feedback, reusability, long term testing, less human resources, reliability or automated documentation. The need of tests automation to increase the effectiveness of software tests together with a demanding schedule, leads to the creation of a Ground-testing framework to validate embedded RLS Application Software requirements. INTA RLS Ground-testing framework is also able to support the validation of operational and scientific requirements, with a set of dedicated system tests scripts that allows the operator to execute Raman operations. Additionally, the framework is able to simulate Raman instrument operation on ground, allowing activity plans to be created and executed.

2. HW Set-Up

The INTA RLS Ground-testing framework HW Set-up is based mainly on RVIS (Rover vehicle Interface Simulator) which simulates power and Rover OBC telecommands (exchanged via CAN Bus).

A sample system controlled through the Operator Workstation allows the user to move a RLS scientific samples holder as well as the Exomars Rover carrousel during the operation in Mars so that RLS could perform different samples process and analysis. The set-up also includes a debug unit for debugging purposes. The set-up and its implementation are displayed in Fig.1 and Fig. 2:

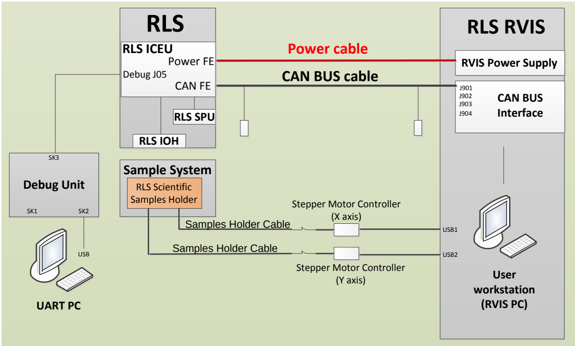

Figure 1. Set-up to perform RLS operation or test

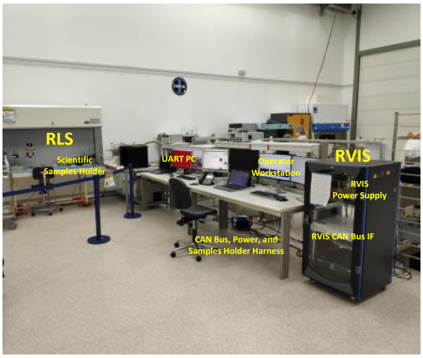

Figure 2. Testing framework inside INTA facilities

3. EGSE Architecture

The RLS functional system ground-testing framework (RLS EGSE) consists in the following parts: RLS RVIS and SW tools developed by RLS team.

RLS RVIS (it is the basis of the system) has the following applications: coreCMDVS (Control, Monitoring, Data processing and Visualization Software), TSC (Test Sequence Controller: IF with IDB, supports functions like: Test script (tcl) execution… [2]), RIF (Remote Interface) and other supporting tools like CAN BUS Monitor, DBM, Archive browser and Log browser

The End-to-end ground-testing framework for RLS is based on major applications managed by TCL scripts running on the TSC. Fig. 3 illustrates the overall system: the operator configures and selects the tests to be commanded in the graphical interface application “RLS RVIS Scripts App” which creates an input file (either Scripts_Input.txt or ActivityPlan_Input.txt) depending on the selection (RLS test / RLS operation) made by the operator. Then, executes the corresponding scripts in TSC so that the RLS test or operation starts. The operation is managed by the instructions from TSC scripts allowing CMDVS to power the instrument and exchange TCs and TMs. In the meanwhile, the operator can follow the execution using RLS IDAT to view the housekeeping or the science spectra sent by the instrument in real time.

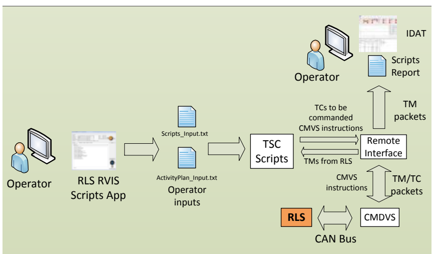

Figure 3. RVIS EGSE Architecture

4. Graphical User Interface

RLS RVIS Scripts App is a software tool used for the command and control of the INTA RLS Ground-testing framework. The application allows the user to configure and command RLS scripts. The main window is displayed in Fig.4:

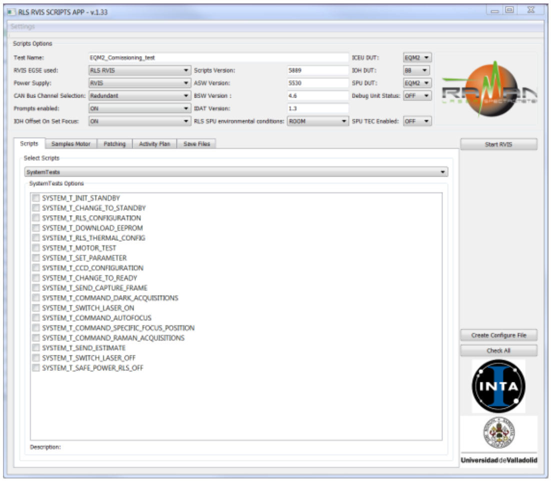

Figure 4. RLS RVIS Scripts Application

5. Conclusions

The INTA RLS Ground-testing framework has been widely used during development and AIT phases of RLS instrument qualification and flight models in functional test , SW verification tests, unit tests, thermal tests, EMC tests, system performances tests or science test. Every operation performed by the Ground-testing framework is automatically recorded and documented; therefore, the automated testing framework brings also many advantages in terms of traceability or version control. The Ground-testing framework is also a powerful tool for helping to prepare the daily activity plans, verify and confirm their suitability in terms of time and data budgets, as well as for the analysis and replication of problems occurred during the operation in Mars due to its capability of simulating the execution of activity plans.

6. Acknowledgements

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7. References

[1] Rull, F., et al., “The Raman Laser Spectrometer for the ExoMars Rover Mission to Mars”, Astrobiology, Vol. 17, Num. 6 and 7, 2017.

[2] Clif Flynt, “Tcl/Tk A Developer’s Guide”, Third Edition, 2012