SPACE EXPLORATION SYMPOSIUM (A3)
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MEDA, SIX SENSES FOR THE NASA MARS2020 ROVER: DESIGNING A VERSATILE INSTRUMENT TO PULSE THE MARS CLIMATE

Abstract

The Mars Environmental Dynamics Analyzer (MEDA) is one of the seven science instruments of the NASA Mars2020 rover mission. Its six sensors are designed to record the local dust properties and the surface weather conditions on Mars, around the clock. MEDA, as human senses work, is able to measure autonomously and continuously, independently from rover iteration, even when it is sleeping.

MEDA contains six sensors spread over the rover, which collect the following environmental magnitudes: atmospheric temperature (Air Temperature Sensor); relative humidity (Humidity Sensor); atmospheric pressure (Pressure Sensor); radiation in different discrete bands of the UV, visible and IR ranges of the spectrum (Radiation and Dust Sensor); infrared radiation emitted by the ground, the sky and the atmosphere (Thermal Infrared Sensor); and finally, wind speed and direction (Wind Sensor). In addition to the six sensors, the Instrument Control Unit (ICU) manages the data acquisition, communicates with the rover and stores scientific and engineering records.

During the early stages of the instrument design, the need of building a flexible tool as to adapt to the plausible surface mission operations scenarios (in terms of activities timing, power, and data budgets) arose. Available resources on board the Mars2020 rover will strongly determine the quantity of measurements MEDA will be able to acquire.

Two in flight capabilities has been designed to turn MEDA into a versatile instrument: the namely Observation Tables (OTs) and a MEDA optimized compression algorithm.

An OT is a set of commands loaded into the instrument mass memory, which allows MEDA to work autonomously, without iteration with the rover. OT's commands govern MEDA acquisitions, allowing different configuration options: duration, sampling rate or parallelization, for example. Besides that, OTs are reusable. One OT can invoke itself once it is finished, or even another OT. Finally, OT execution is compatible with rover iteration, allowing certain activities running in parallel with sensors' acquisition, such us downloading data to the rover.

Finally, a lossless delta compression algorithm has been designed to compress the acquired data in the Instrument Control Unit. Preliminary analysis based on environmental time series from the REMS instrument on Mars Curiosity rover shows mean reductions up to 50%.

In conclusion, MEDA, thanks to its in flight capabilities, will increment the quantity of data acquired, producing a continuous record of environmental magnitudes from the Mars surface.