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THE MARS TERRAIN SIMULATOR: AN INDOOR ANALOGUE FACILITY TO VALIDATE AND SIMULATE EXOMARS ROVER OPERATIONS AND TO SUPPORT THE EXOMARS SURFACE MISSION

Abstract

The Mars Terrain Simulator (MTS) is an indoor analogue facility located in Turin at ALTEC premises, designed to reproduce, from a morphological and mineralogical point of view, the Mars terrain characteristics at the landing site and to support the daily ground operations through rehearsal and troubleshooting on representative hardware and instrumentation.

The MTS is part of a wider ground control facility known as the Rover Operations Control Centre (ROCC), where the operations of the ExoMars Rover will be monitored, commanded and controlled.

This paper explains why the MTS facility is one of the most advanced facilities to perform Rover functional testing and to give the adequate support to the Rover surface mission in case of contingency.

The principal area with the Mars surface physical characteristics is the Arena, a 20x16 meters zone with two soils that provide different Rover wheels slippage conditions. The Arena is composed of a Sandy Area with a very fine sand, the Rheinquartz Phyllosilicates, and a Mobility zone with a cloddy silty sand, the Pozzolana Volcanic Tuff, where it is possible to perform Locomotion, Egress from a Lander Mock-up and Climbing tests.

The terrain can be adapted to create Mars soil features, such as dunes, crevasses, ramps or hills. These reconfigurations are performed using support equipment available in the facility: hand tools, pallet jacks and a bridge crane able to lift up to 10 tons. Slopes can be created using the Tilting Platform, an 8x8 meters mobile ramp tiltable up to 30 deg while crevasses are generated using ad-hoc devices. The Mars gravity is simulated using the Gravity Compensation Device.

The drilling operations are performed outside the Main Arena on a defined zone, the Drilling Facility. A cylindrical drilling well can be filled with several materials organized in layers. The Rover cameras optical tests are executed inside the Illumination Facility, a 4x4 meters area located under the Drilling Facility. This specific zone is surrounded by 28 dimmable lamps used to simulate the sun light coming from different directions.

The Rover operations are monitored using two sets of cameras mounted around the Arena: 12 OptiTrack infrared cameras track the Rover motions, while 40 digital cameras generate a Digital Elevation Model (DEM). The output provided by these cameras allows also the reconfiguration of the terrain as the one detected by the Rover Panoramic Camera on Mars and, as consequence, to recreate the Rover contingency scenario inside the arena.