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ULYSSES - A STATE OF THE ART SANDBOX SIMULATOR FOR PLANETARY SURFACES

Abstract

In this paper, we explore the proposed architecture of ULYSSES, a universal physics-based planetary surfaces exploration simulator, which is based on the Unreal game development engine framework (Unreal Engine 5). This simulation environment was created to serve as a digital testbed or 'sandbox' for the development and validation of future robotic missions to the Moon, Mars and elsewhere in the Solar System.

It is clear that the future of robotic exploration lies in the increased automation of its software, in both planning as well as operations. The development of optical navigation and pathfinding and mission planning software is largely hindered by the lack of available data for the real environments the rovers must operate in. The creation of sufficiently large scale analog sites on Earth is prohibited by cost and time constraints. With the advent of next generation game engines incorporating state of the art real-time physics engines, ray tracing and rendering modules, we can turn to the digital production of the necessary datasets, needed to reach new heights in autonomous rover operations well in advance of landing in a foreign world.

The proposed ULYSSES framework allows for the procedural generation of photorealistic environments and landscapes on a base map, synthesised from multiple digital elevation models of differing resolution provided by remote sensing satellites. The addition of ultra realistic lighting, time propagation and an actor capable of interacting with its environment in a natural way allows the simulator to provide crucial feedback, training and validation datasets in varied configurations to future mission critical software for robotic missions off-Earth. The first phase of ULYSSES development will focus on the validation of the framework on the basis of a semi-autonomous solar powered Lunar lander targeting the Apollo 15 landing site in Hadley, which incorporates automated path and mission planning software. This software toolkit is developed in parallel to and supporting our project "Operations and mobility planning system for Lunar rover missions" with Milrem Robotics and ESA ESOC. The results of this development phase of the simulator are presented in the article.