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PYRODUCT: A PARAMETRIC TOOL FOR GENERATING REALISTIC 3D MODELS OF LUNAR AND MARTIAN LAVA TUBES

Abstract

On the Moon and Mars, recent studies have shown the possible existence and extent of underground conduits, known on Earth as "lava tubes" or "pyroducts". Despite knowing the location of some of these features, it is not possible, at present, to assess their interior, which remains an open question. At the moment, when represented, especially in space architecture design proposals, lava tube interiors are depicted as purely notional or fictional, lacking, in most cases, a scientific rationale. On Earth, lava tubes have been studied for a long time, and lots of data are available regarding the interior assets of many of them worldwide. In particular, current research agrees that Martian and Lunar lava tubes might share similar genetic mechanisms with Terrestrial ones, with the main difference being the internal dimensions, which, in the case of Mars and especially the Moon, would be significantly bigger. In the present research, with the use of Rhinoceros's visual programming language Grasshopper 3D, we have developed an algorithm that is capable of generating accurate 3D models of lava tubes by interpolating the available data of mapped Lunar and Martian pyroducts paths with Terrestrial lava tube survey data. Due to the increasing interest in underground space habitats and lava tube architectures, because of their capability of shielding future settlers from environmental factors such as radiation, extreme temperatures, and the impact of micrometeorites, this paper aims to provide a tool for more realistic lava tube representations, as they would provide a more appropriate context for performing analysis and evaluations, but also for logistics and space architecture planning. Lava tubes are a terrific resource that might enhance a future sustainable space exploration: geological resources that are already available to be used and adapted for sheltering and habitation purposes are an invaluable resource that dares further investigation.