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IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Space Transportation Solutions for Deep Space Missions (8-A5.4)

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FROM ROVERS TO ADVANCED LUNAR TRANSPORTATION: A PROPOSAL FOR AN ELEVATED TRAIN SYSTEM

Abstract

An international team of students and young professionals developed new ideas for future exploration of Moon, Mars, and asteroids at the second International Space Exploration Forum for Young Professionals (Y-ISEF), held in Tokyo. The method used to create innovative ideas consisted of three steps: problem definition, value proposition and approach. In the first step, the team explored a general problem from different viewpoints trying to derive a more concrete and specific issue; in the second, we analyzed the benefits generated by the solution of the previously defined problem; in the third, we describe the solution and its implementation.

The capability to build permanent communities has been related not only to the resource availability, but also to transportation. In the initial phases of lunar colonization, the development of infrastructure will be limited by the capability to efficiently move resources, materials, and people between two locations on the moon. In this context, how is it possible to develop a high speed and autonomous transportation system when lacking centuries of infrastructure like we have on the Earth? Short term solutions like rovers and longer term projects like lunar maglev rails have been proposed, but less attention has been paid to intermediate solutions. We propose a roadmap for the implementation of transportation systems on the Moon starting from the 2020s, focusing on these intermediate steps.

For early phases, rovers can be used, but they are slow and negatively impacted by lunar dust. Low gravity and lunar soil pose serious traction problems, restricting maneuverability. Also, the levitated dust poses threats to wheeled machines as accumulation of dust within the delicate components can cause malfunction. For intermediate phases, from 2030s, and distances up to a few kilometers, we propose to mitigate problems related to dust and regolith by elevating the transport with a cable car system. This system is expected to overcome problems related to direct contact with lunar surface and subsequently provide an efficient transportation which is unaffected by uneven terrain or craters. Elevated by cables and equipped with radiation proof pressurized cable cars, this will allow transportation of humans and materials safer and more swiftly. In a more advanced phase, to connect a larger community, we propose a rail system constructed by using in-situ materials, like waterless concrete. We analyzed problems related to the construction of this infrastructure and discuss mitigation strategies.