Title:

Stress distribution beneath the wheel of a lunar/planetary rover on loose soil

Abstract:

The target environment for lunar/planetary exploration, such as the surface of the Moon and Mars, is covered with fine granular material, called regolith. The wheels of an exploration rover easily slip when traveling on such loose soil. Wheel slippage adversely affects its path-following performance, and in the worst case, a wheel is buried in the soil and gets stuck. To prevent such situations, understanding of the wheel-soil interaction is quite important.

The research field regarding wheel-soil interaction is called "terramechanics" and was originally studied with heavyweight vehicles (e.g., construction machines, agricultural machines, or military vehicles). In recent years, terramechanics has been applied for lightweight vehicles such as lunar/planetary rovers.

Modeling of the normal and shear stress distribution under the contact patch of the wheel is the key to predicting the traction force, slippage, and sinkage of the wheel in the given terrain and soil conditions.

In the research field of terramechanics, the stress distribution has been modeled and validated for heavyweight vehicles. However, of late, some researchers have pointed out that the classical model does not give us reasonable results for lightweight vehicles.

Since I became a master's program student, I have been deeply devoted to the experimental measurement of stress distribution by a force/torque sensor embedded inside a wheel, and have collected useful data to understand the stress distribution under the wheel of a lightweight vehicle.

In this talk, first, I will introduce past research activities on rover terramechanics conducted at the Space Robotics Laboratory to provide background. Then, I will report the findings from my experiments about the wheel stress distribution.

Biography:

Shoya Higa is a Ph.D. student in the Space Robotics Laboratory at Tohoku University. He completed the Advanced Course of Okinawa National College of Technology and received a bachelor's degree from NIAD-UE (National Institution for Academic Degrees and University Evaluation) in 2012, then he received his master's degree in engineering from Tohoku University in 2014. His research interests focus on mobility performance analysis of lunar/planetary rovers, particularly, wheel–soil interaction (terramechanics). He has been working on experiment-based measurement and modeling of wheel-soil interaction forces (normal stress and shear stress) for lunar/planetary rovers.