# Dynamics Modelling for Rover Simulation on Soft Terrain

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## Abstract

In this presentation, we will discuss modelling, simulation, and analysis methods for the performance evaluation of planetary rovers moving in unstructured environments. We will investigate various terrain modelling approaches. The analysis is based on implementations in CMLabs' Vortex, a dynamics simulation environment for complex mechanical systems. The particular focus is on motion on soft terrain. Semi-empirical models are implemented to represent soft soil and wheel interaction. In addition, a novel approach is developed for the modelling of rigid-wheel and soft-soil interaction using infinitesimal plasticity theory. Our motivation is the need to have a model compatible with dynamic models of multibody systems, which addresses some shortcomings of the semi-empirical representations. While the semi-empirical models were developed for steady-state operation, the new model can represent a broader range of operations including dynamic conditions. In addition, the slip-sinkage phenomenon, an important behaviour observed experimentally in wheel-soil interaction, is a natural outcome of this approach. The model is based on a theoretical continuum mechanics approach, which leads to results that compare favourably with those obtained using well-established semi-empirical models in their validated range of operation. We will also present different multibody dynamics formulations for the analysis and modelling of the behaviour of rovers on soft soil.