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Continuum Simulation of Hybrid Locomotion on Granular Terrain in SPH[1] GUANJIN WANG, AMIR RIAZ, BALAKUMAR BALACHANDRAN, University of Maryland, College Park, COMPUTATIONAL DYNAMICS LAB TEAM[2] — Wheeled robots can move fast on flat surfaces but suffer from loss of traction and immobility on soft ground because of sinkage and slipping. Legged machines, however, have superior mobility over wheeled locomotion when they are in motion over flowable ground or a terrain with obstacles but can only move at relatively low speeds on flat surfaces. A plausible question is the following: If legged and wheeled locomotion are combined, can the resulting hybrid leg-wheel locomotion move fast in any terrain condition? Locomotive interactions are sensitive to the underlaying ground soil, which is a granular material. Continuum treatment is a good choice for dealing with dynamic interaction problems when the particle size of the ground is smaller than the intruder size. A Smooth particle hydrodynamics framework has been proposed for this problem. The mesh-free nature of SPH makes it easy to capture the large deformation and the post-failure state of the granular substrate. Great agreement is found amongst the obtained numerical results and theoretical as well as experimental results across a wide range of robot leg shapes. The results are expected to form a good basis for robot navigation and exploration in unknown and complex terrains.

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