Simulation-Based Optimization of High-Performance Wheel Loading

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indent Smart and autonomous earthmoving equipment may significantly improve energy efficiency, productivity, and safety at construction sites and mines. If the planning and control system can be made well-informed about the physics of earthmoving operations and the current state of the environment, then it can predict the outcome of an action and select near-optimal action sequences that are well-coordinated with other systems at the site. However, no computationally efficient models for wheel loading with realistic soil dynamics have been available until recently. This paper explores the loading actions which maximize the performance over sequential cycles in a simulated environment. The simulator combines contacting 3D multibody dynamics with a hybrid continuum-particle terrain model that supports realistic digging forces and soil displacements at real-time performance [1]. We investigate how the loading actions depend on and alter the state of a soil pile by analyzing the sensitivities to the material properties and the number of consecutive loading cycles. Finally, we estimate the potential performance increase of simulation-based optimization on different wheel loading scenarios.

References

[1] M. Servin, T. Berglund, and S. Nystedt. A multiscale model of terrain dynamics for real-time earthmoving simulation. *Advanced Modeling and Simulation in Engineering Sciences*, `https://arxiv.org/abs/2011.00459` (2021).