

Joint Optimization for Transport and Bucket Loading Phases of Automated Wheel Loaders

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Abstract:

This paper investigates optimization of fuel-efficiency and productivity for automated wheel loaders. A control-oriented model for both the transport phase and bucket loading phase is proposed. The vehicle model includes an automatic gear shift schedule that can be incorporated into the optimization problem. Based on the model, the multi-stage optimization problem is formulated to simultaneously consider all phases of a short cycle with physical constraints. Cycle time and fuel efficiency are used as the weighted performance indexes in a multi-objective cost function. Bucket fill factor is included as a constraint during the bucket loading phase. A nonlinear programming problem is created with collocation using MATLAB and CasADi. The optimization solver IPOPT solves the problem to obtain the optimal state and control trajectories, which can be used as a reference for automated wheel loaders or even as a driver advisory for human-driven wheel loaders.