Simulation-to-reality transfer to control a forwarder with active suspensions through deep reinforcement learning

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ABSTRACT

Automating the loaded and unloaded driving of a forwarder has the potential to reduce operational costs up to 10% in cut-to-length logging [1], but remains a challening and unsolved task. The complex interaction between the vehicle and terrain requires the controller to percieve its surroundings and the state of the vehicle to plan for traversal. Because the state space is high dimensional and the system dynamics cannot be formulated in closed form or easily approximated, traditional control methods are inadequate. Under these conditions, where learning to act in the environement is easier than learning the system dynamics, model free reinforcement learning is a promising option. We use deep reinforcement learning for control of a 16-tonne forwarder with actively articulated suspensions. To efficiently gather generalizable experience, the control policies were safetly trained in simulation while varying several domain parameters. Each policy is trained during what correponds to roughly one month of real time. In simulation, the controller shows the ability to traverse rough terrains reconstruced from high-density laser scans and handles slopes up to 27°. To compare the simulated to real performance we transfer the control policies to the physical vehicle. Our results provide insight on how to improve policy transfer to heavy and expensive forest machines.

REFERENCES

[1] M. Lundbäck. Roadmap for teleoperation and automation of forwarding. 2022.