Mobility Assessment of Wheeled Robots Operating on Soft Terrain

McGill | MDA

B. Ghotbi, F. González, J. Kövecses, J. Angeles

Objectives

◉ Rover mobility improvement in unstructured environments
◉ Introducing design and operational guidelines
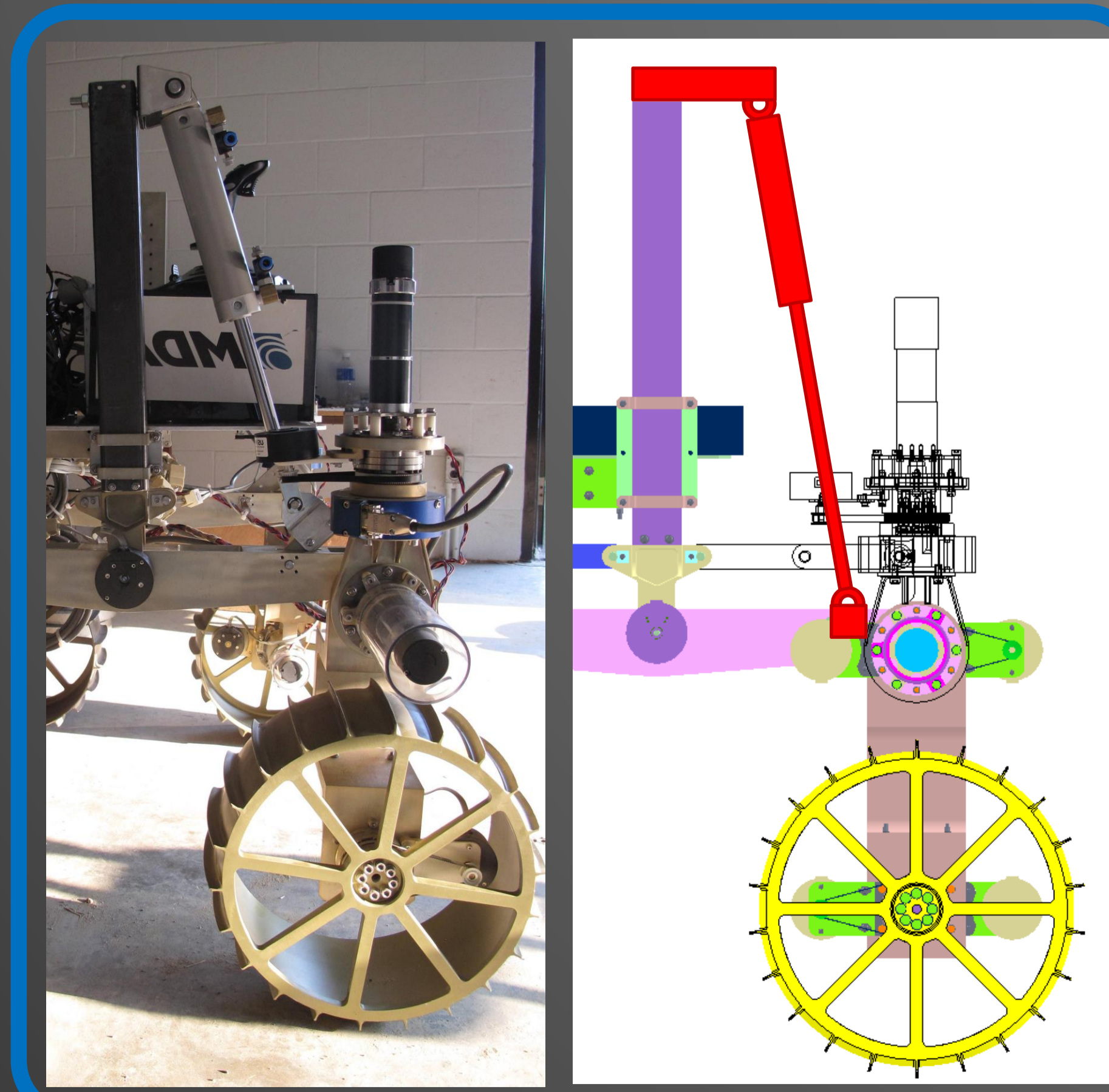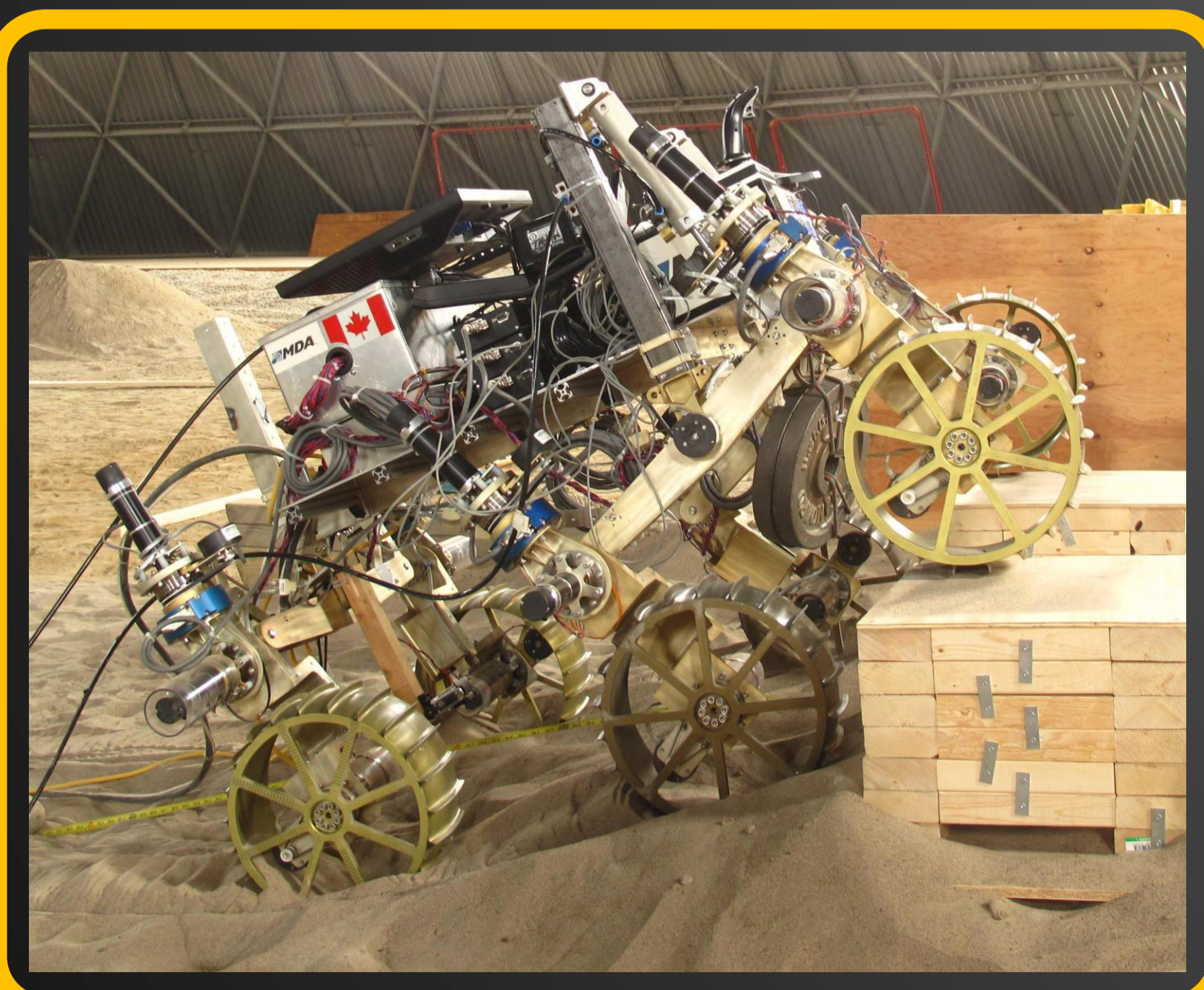◉ Simulation and experimental study of the proposed methods

The goal for rover performance improvement

◉ Manoeuvres on soft terrains: Maximizing the available drawbar pull
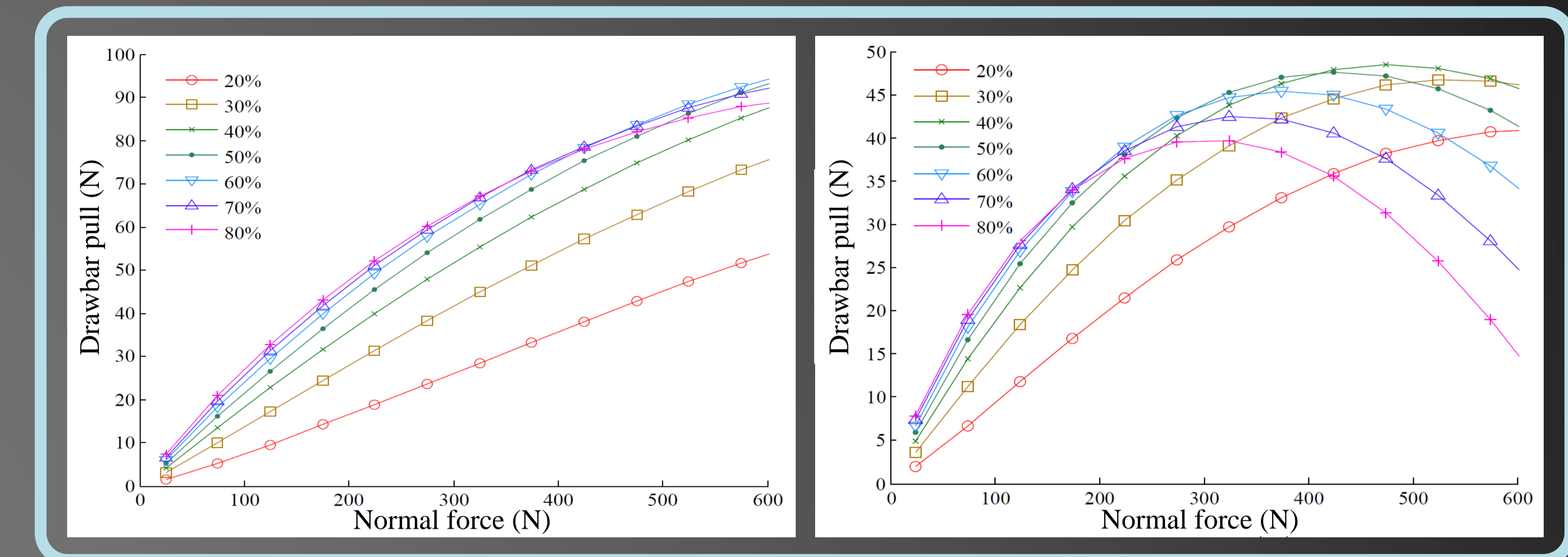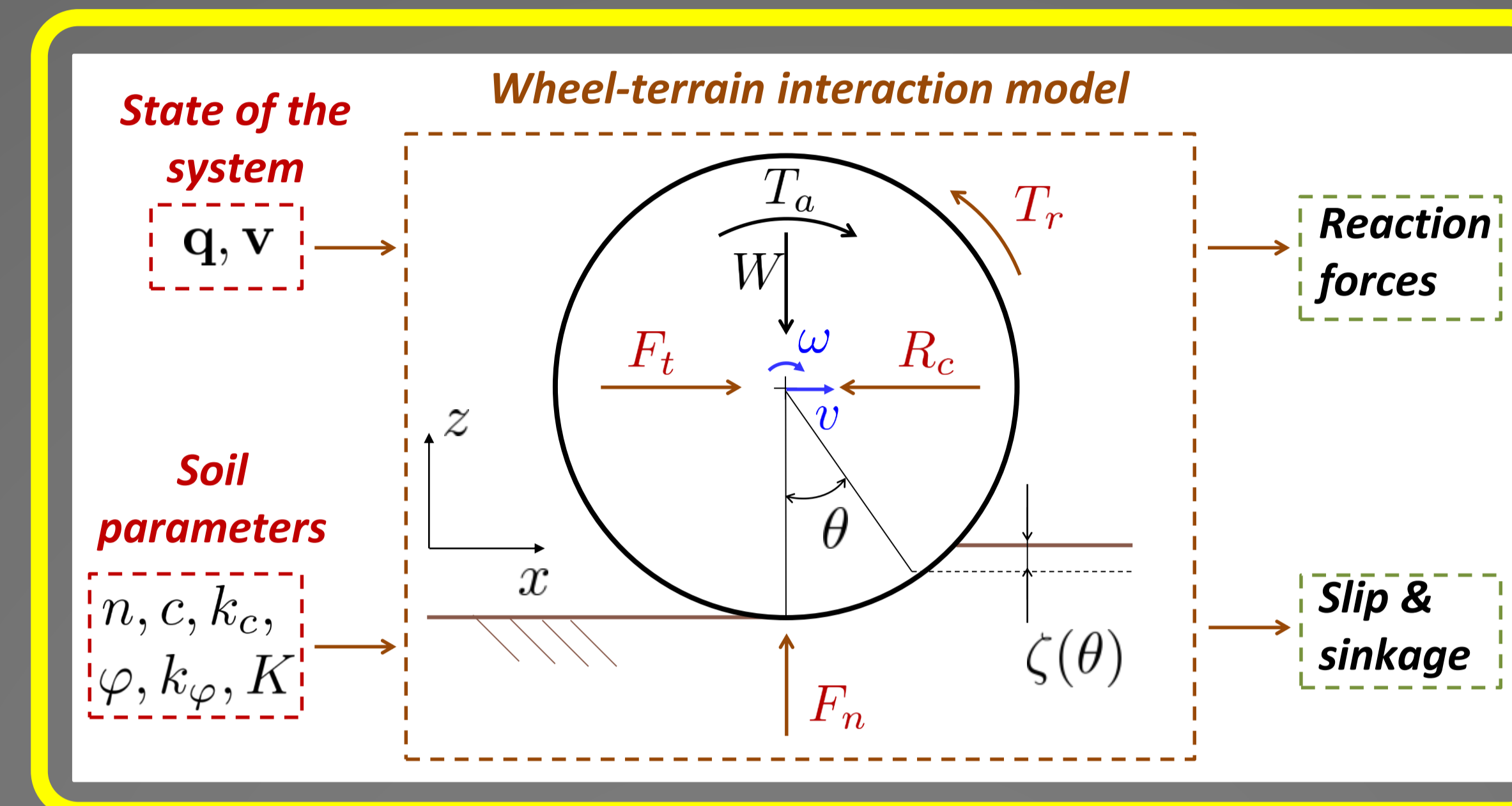◉ Obstacle climbing: Minimizing the torque requirement of wheel motors
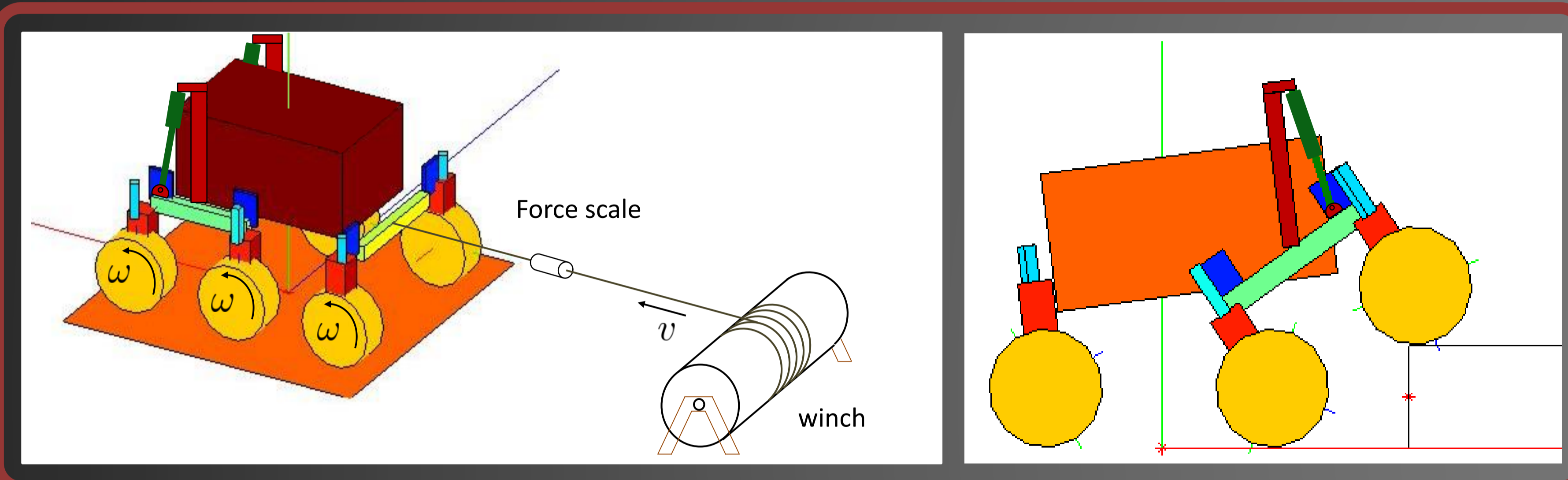
Modification of the chassis internal force distribution

◉ Centre of mass repositioning
◉ Active suspension

Simulation and experimental studies

◉ The relation between the normal and tangential forces for different values of the wheel slip was studied by simulating a single-wheel test bed
◉ The shape of the curve implies that there exists an optimum normal force distribution which maximizes the total available drawbar pull

Wheel-terrain interaction model

State of the system
$\mathbf{q}, \mathbf{v}$ →

Soil parameters
$n, c, k_c,$
φ, k_φ, K →

→ Reaction forces
→ Slip & sinkage

Simulation and experimental studies

◉ Simulation and experimental results of the RCP manoeuvre on soft terrain show significant improvement in the rover performance via modification of internal force distribution
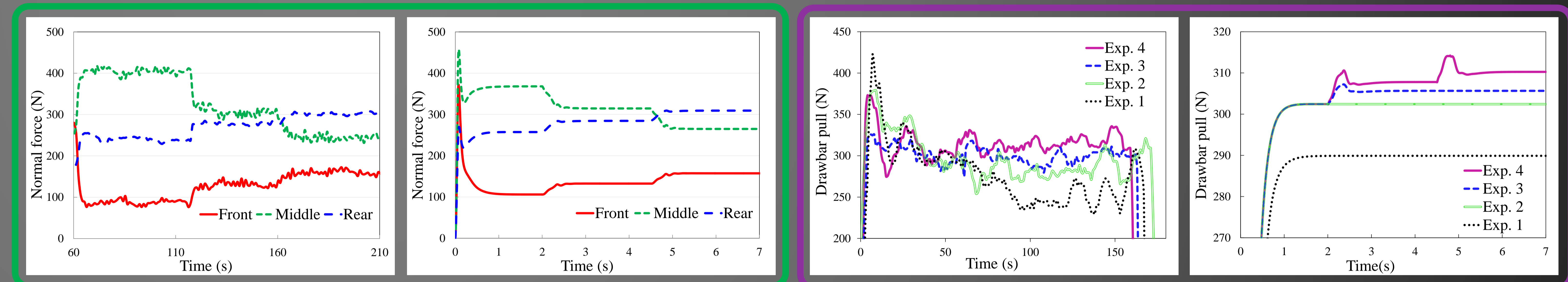
Multipass effect

◉ In case of multi-axle vehicles the soil properties change after each wheel passage, and so does the relation between the normal and tangential forces
◉ This effect was taken into account when solving for the optimum normal force distribution
◉ Simulation results are generated using an in-house developed multibody dynamics library