Modelling and Analysis Methods and Tools to Support Mobile Robotics Design and Control

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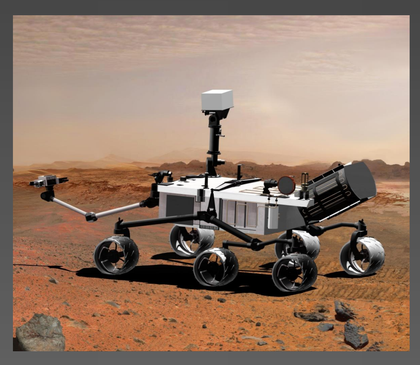
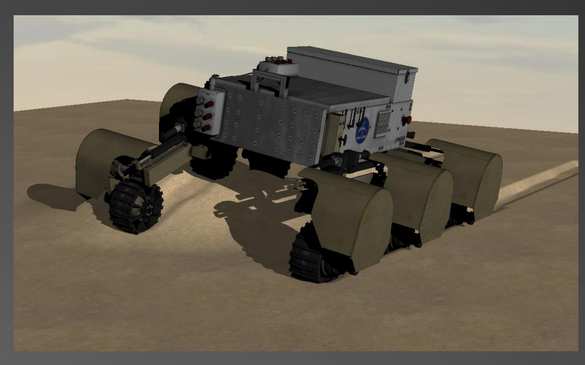
Objectives

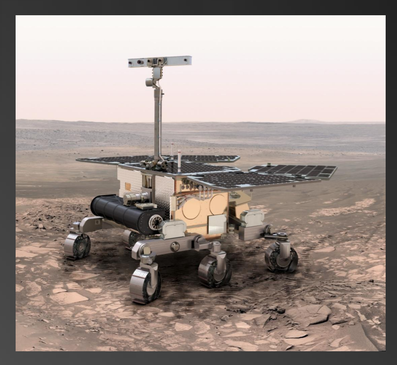
- Improve the design and operation of planetary rovers
- Quantify the effect of system parameters on rover behaviour via definition of performance indicators
- Systematic comparison of different rover designs



Curiosity (NASA)



CBR (MDA)



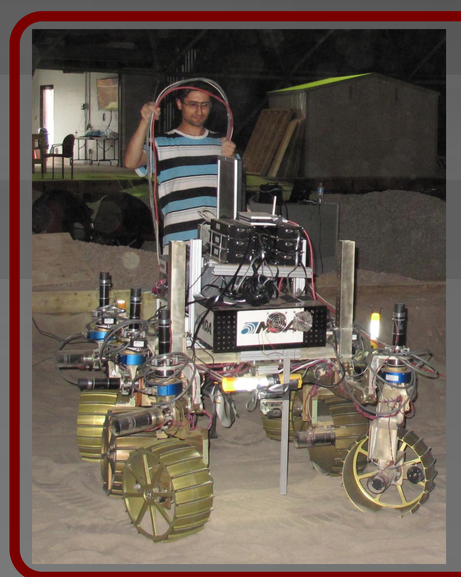
ExoMars (ESA)

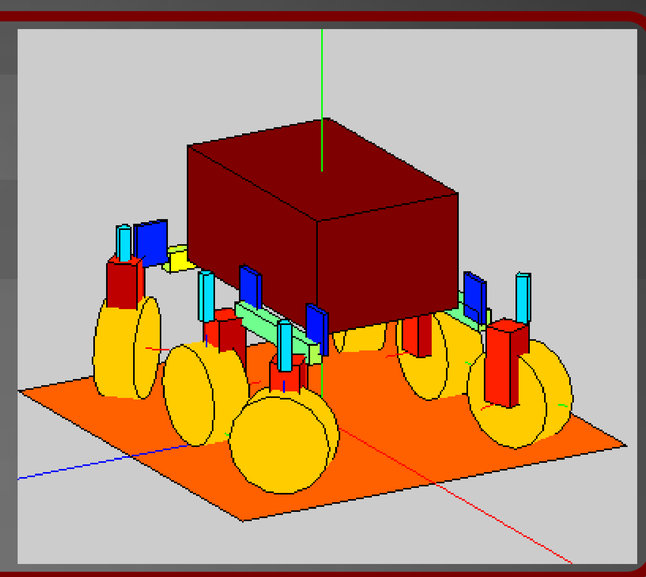
Performance indicators

- Mobility
- Stability
- Maximum force in impacts

General Purpose Multibody Software

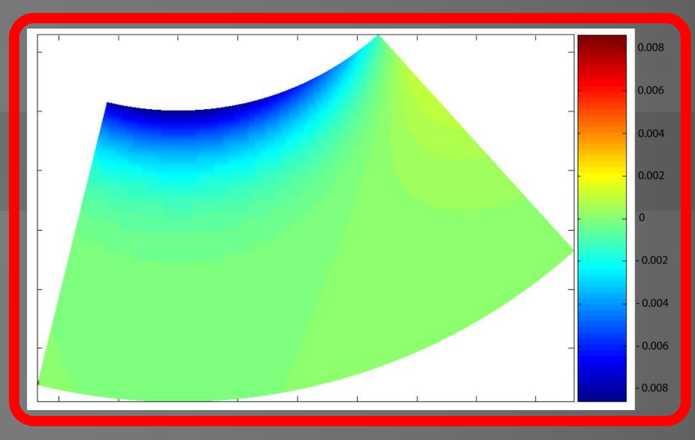
- Access to dynamic terms
- Choice of various multibody dynamics formulations and integrators
- Solution to non-holonomic and redundantly constrained systems
- Several contact and terramechanics models implemented
- Solution of problems in forward- and inverse-dynamics settings
- Graphic representation capabilities





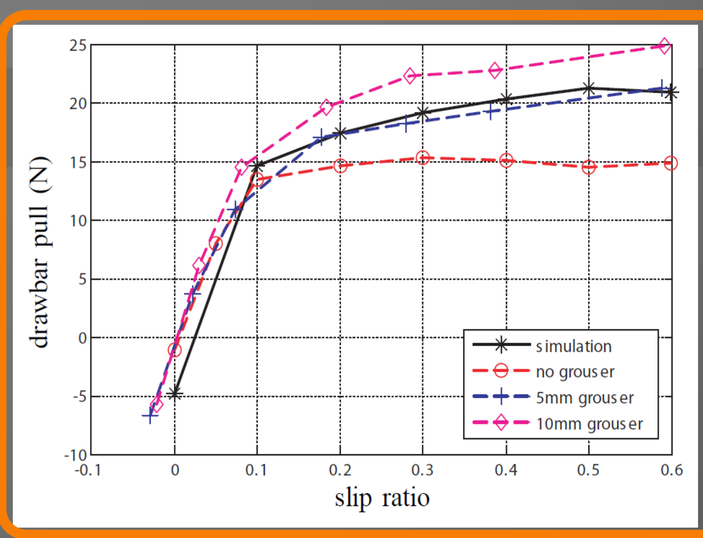
Novel plasticity-based model

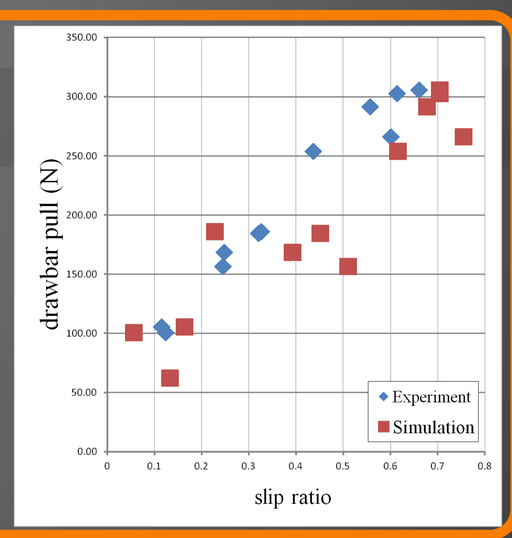
- Captures dynamic phenomena
- Addresses slip-sinkage effects
- Incorporates soil compaction and hardening (multipass)
- Appropriate for real-time applications

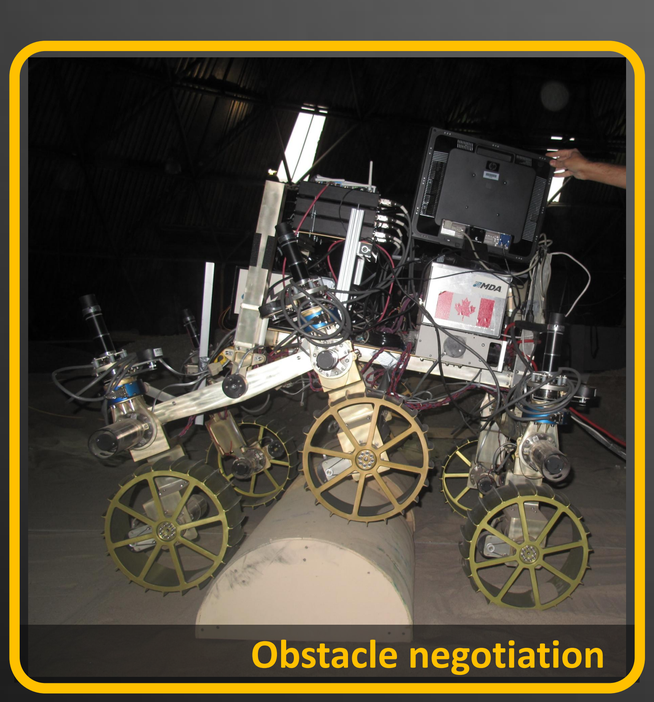


Experiments with Rover Chassis Prototype (RCP)

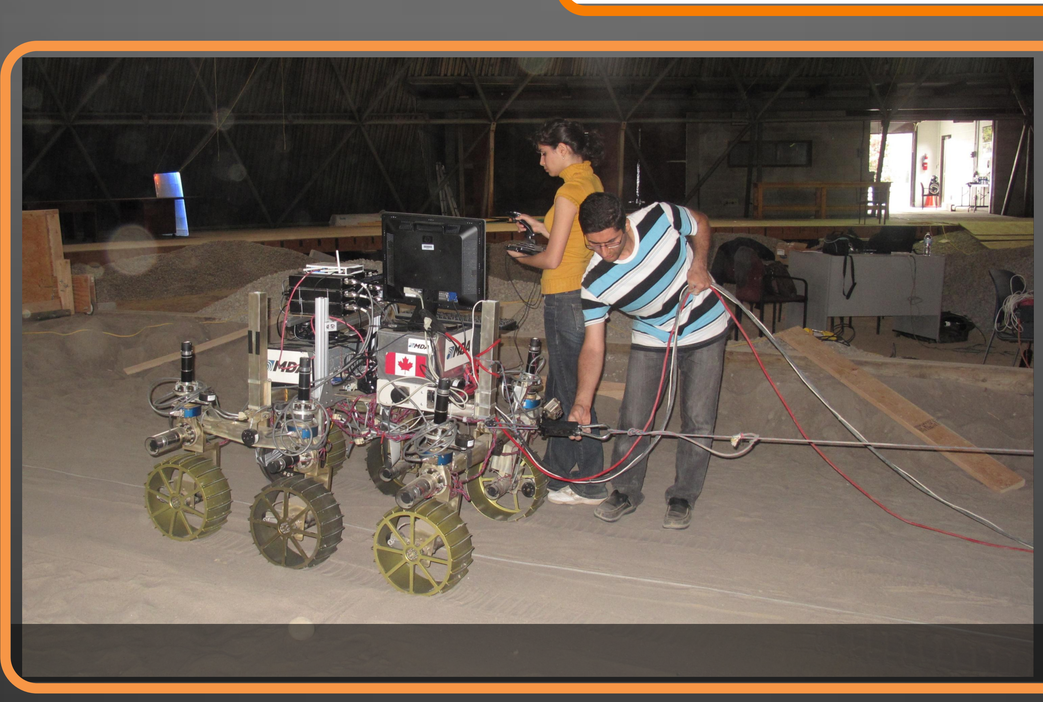
- Calibration
- Drawbar pull test
- Motion with variable slip ratios
- Climbing slope
- Negotiating obstacles







Obstacle negotiation



Drawbar pull test

- B. Ghotbi, F. González, J. Kövecses and J. Angeles. Vehicle-terrain interaction models for analysis and performance evaluation of wheeled rovers. In *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems IROS 2012, pages 3138-3143. Vilamoura, Portugal, 2012.*
- A. Azimi, J. Kövecses, J. Angeles. Wheel-Soil Interaction Model for Rover Simulation and Analysis Using Elasto-Plasticity Theory. Accepted in *IEEE Transactions on Robotics, 2013.*