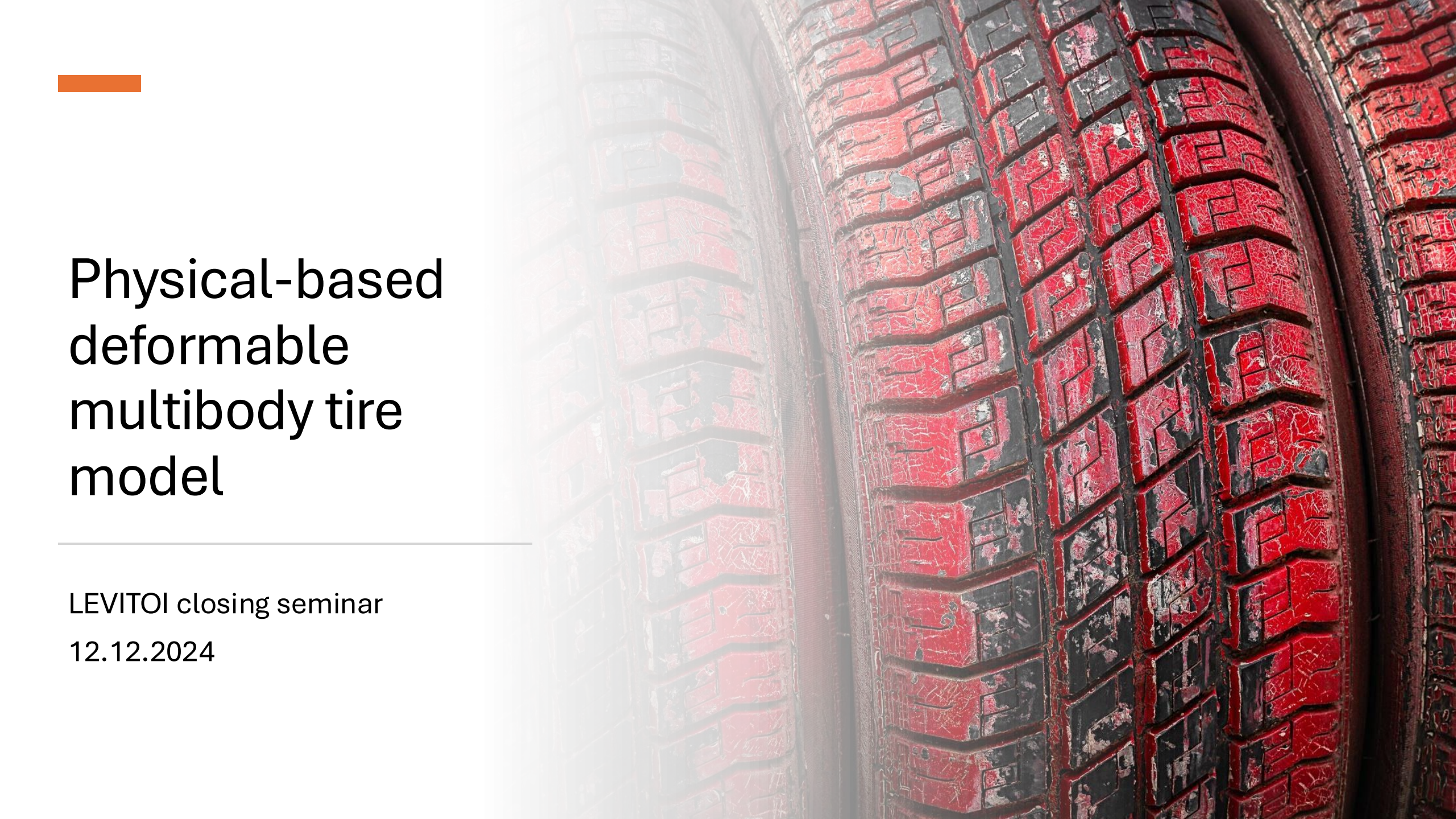
Physical-based deformable multibody tire model

LEVITOI closing seminar

12.12.2024

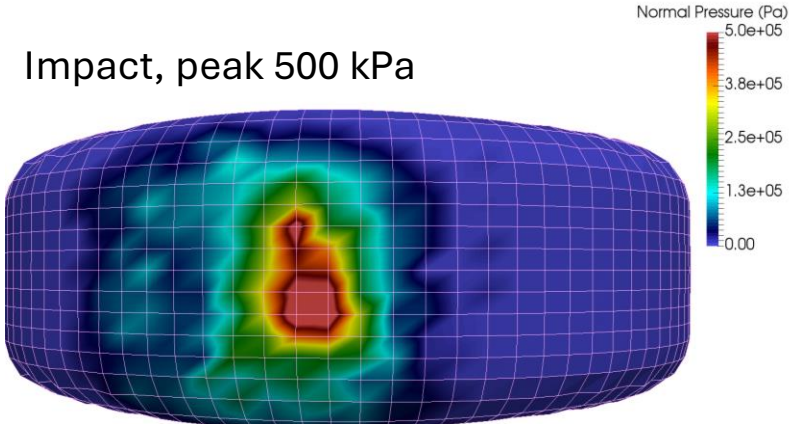


Intro

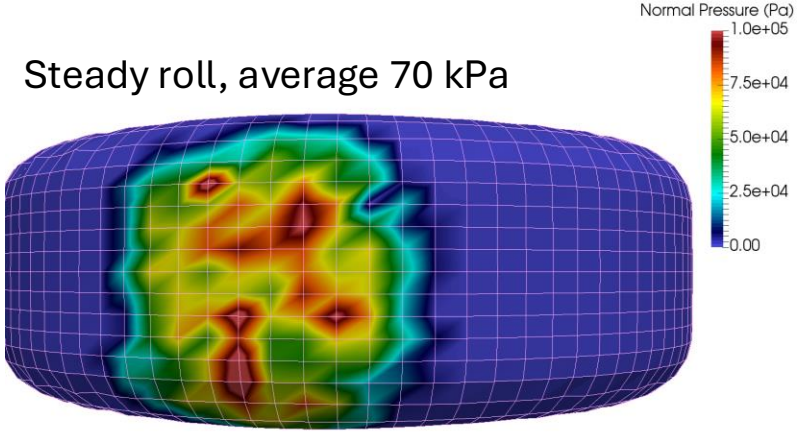
Is soil and tire deformation important?

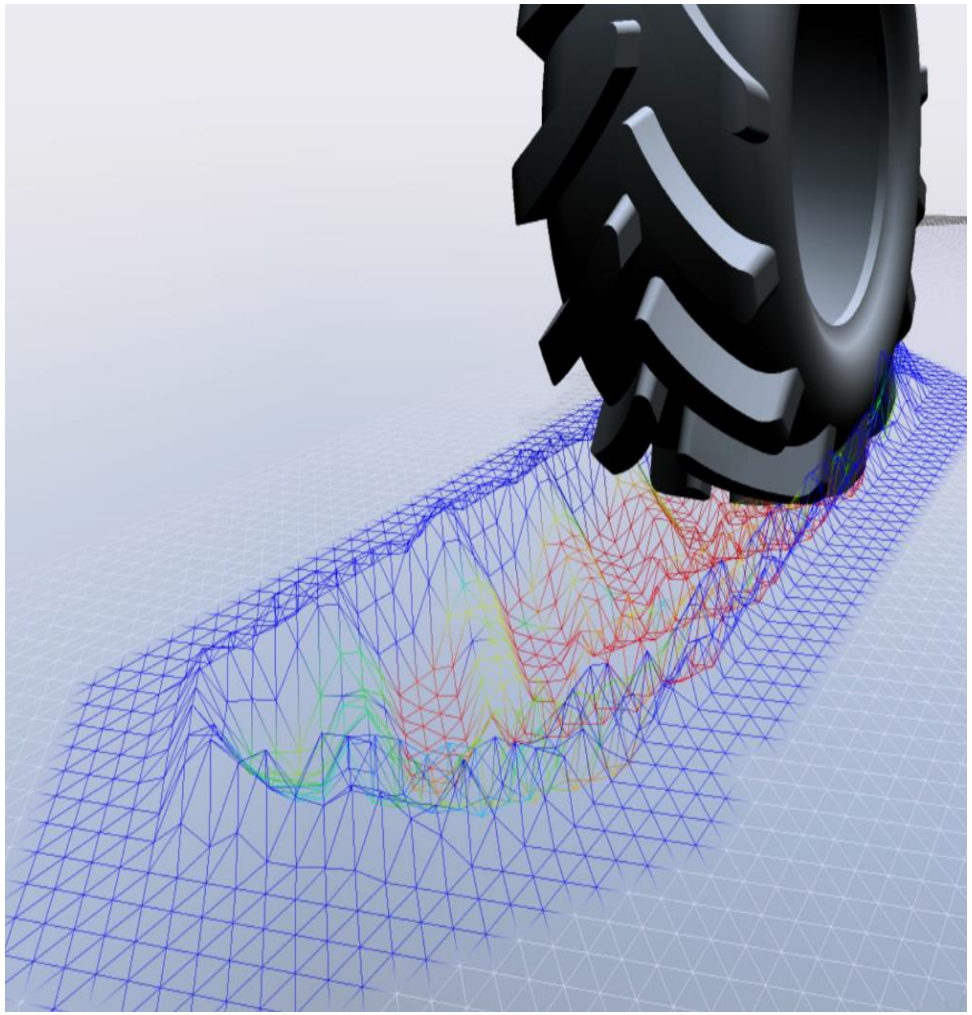
Intro

Impact, peak 500 kPa



Steady roll, average 70 kPa





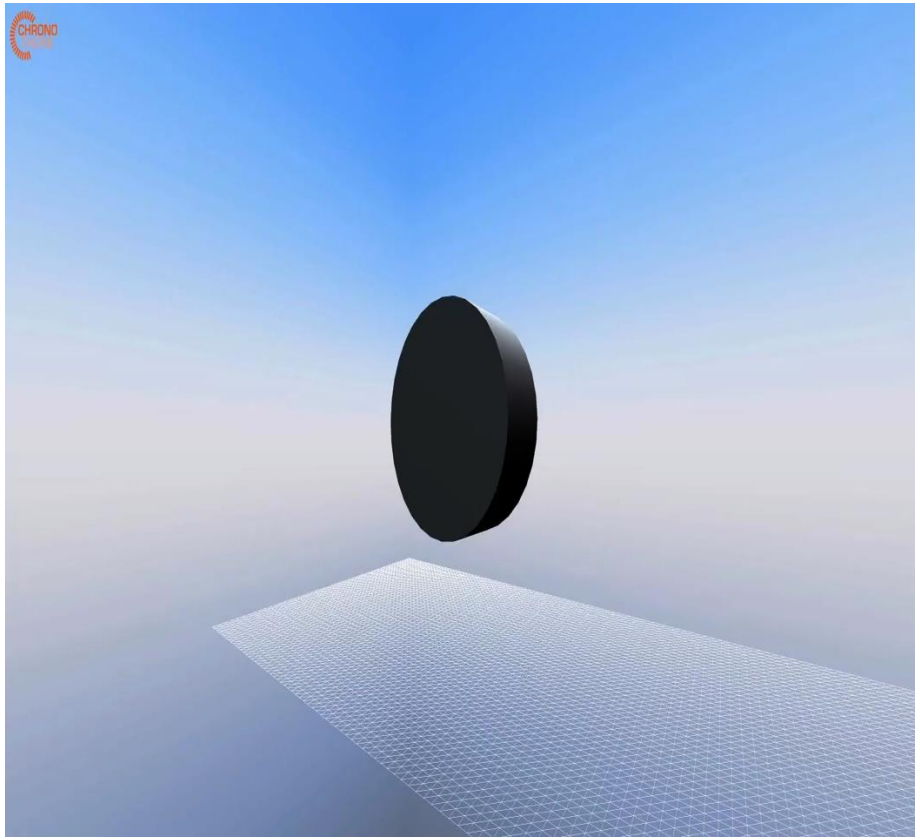
Modeling strategies (tire, soil, and their interactions):

- Physical-based
  - FEM
  - DEM
  - Etc.
- Empirical-based
  - Pacejka
  - Assumptions (like rigidity)
  - Etc.

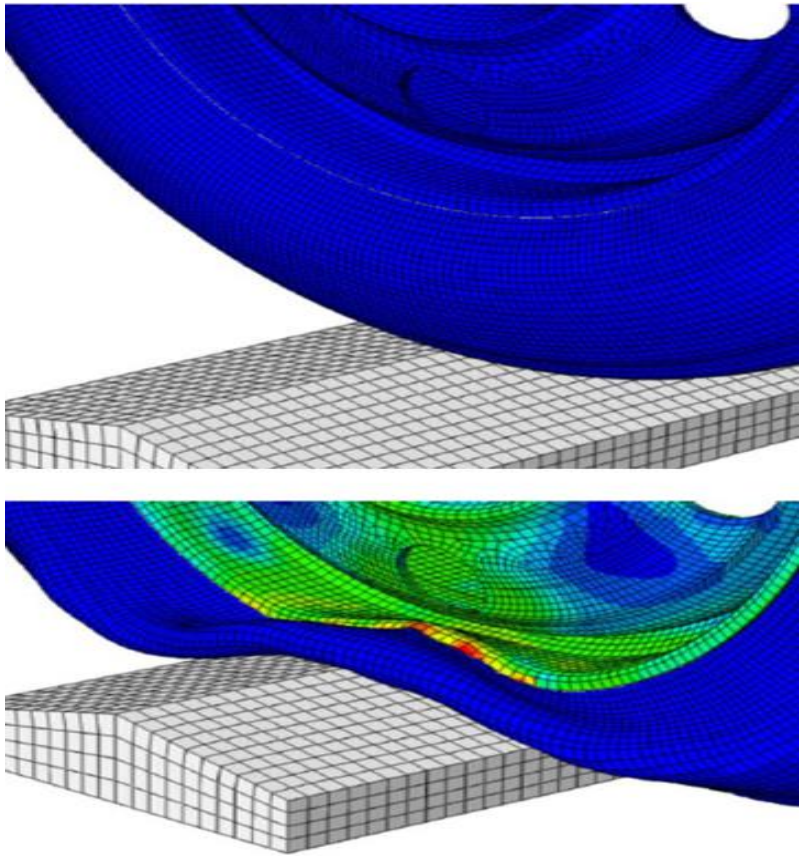
Current simulation possibilities (Physical-based)

Intro

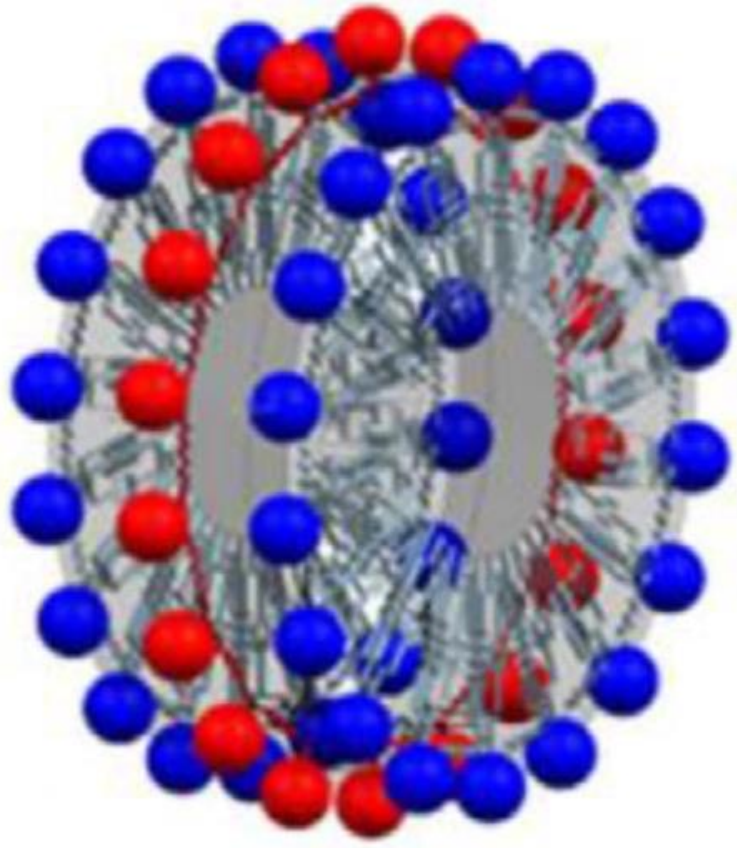
Is something in between?



Speedily and limited

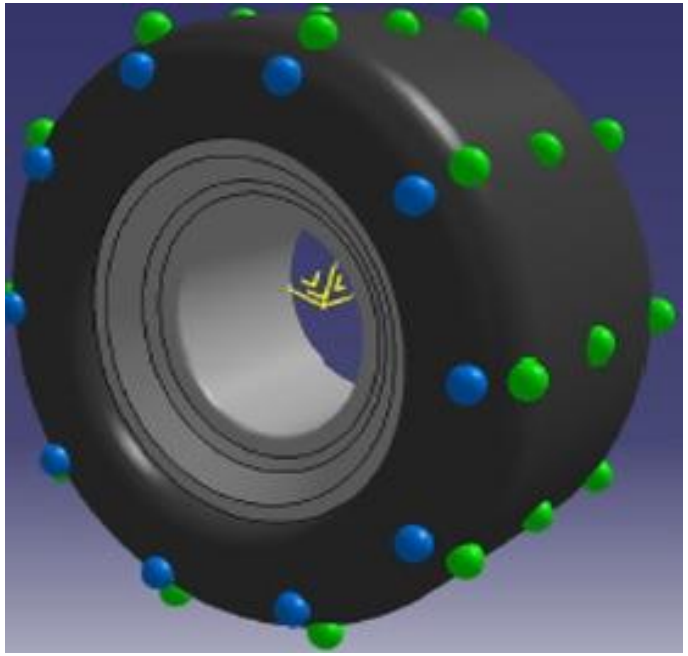


Quality and timely

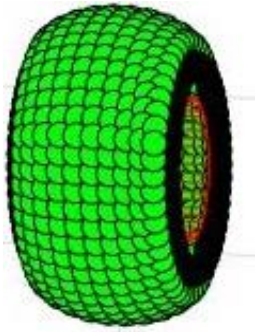


Idea & Proof of Concept

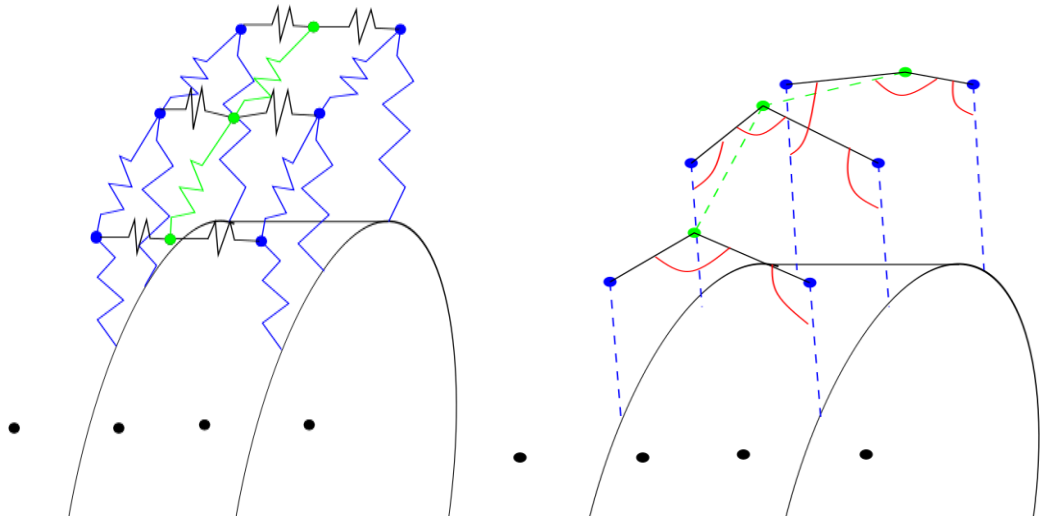
The key difference: How and what kind of springs are used?

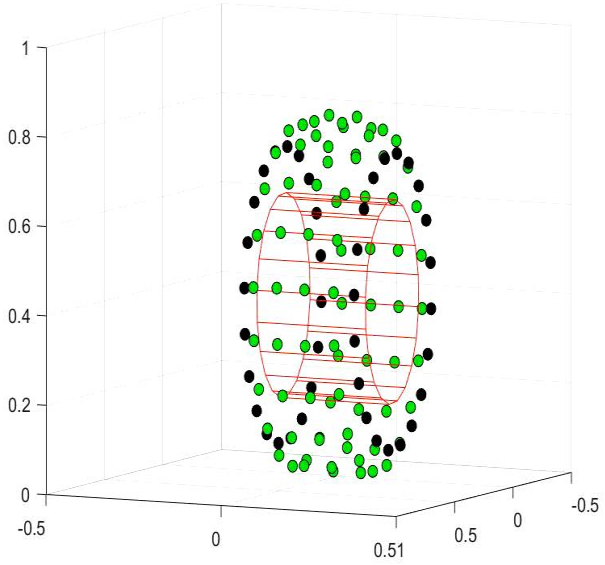


- Discretization scalability:



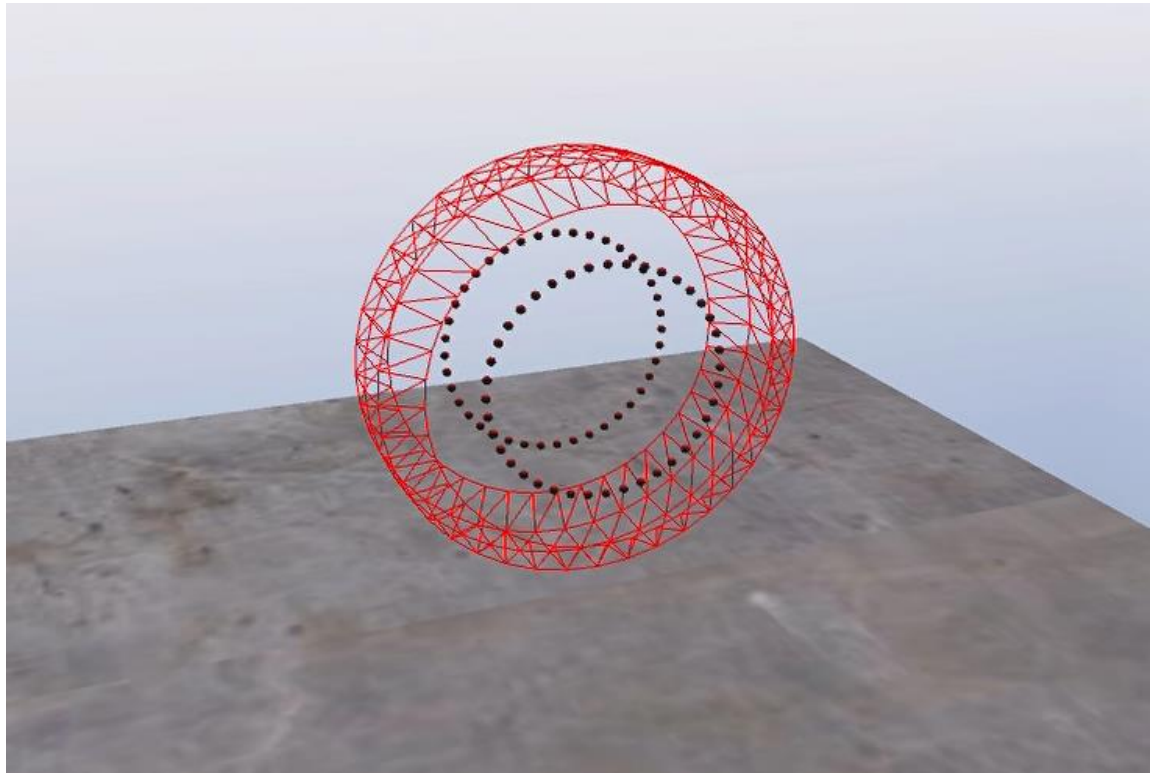
- Parameter minimization with “new spring”

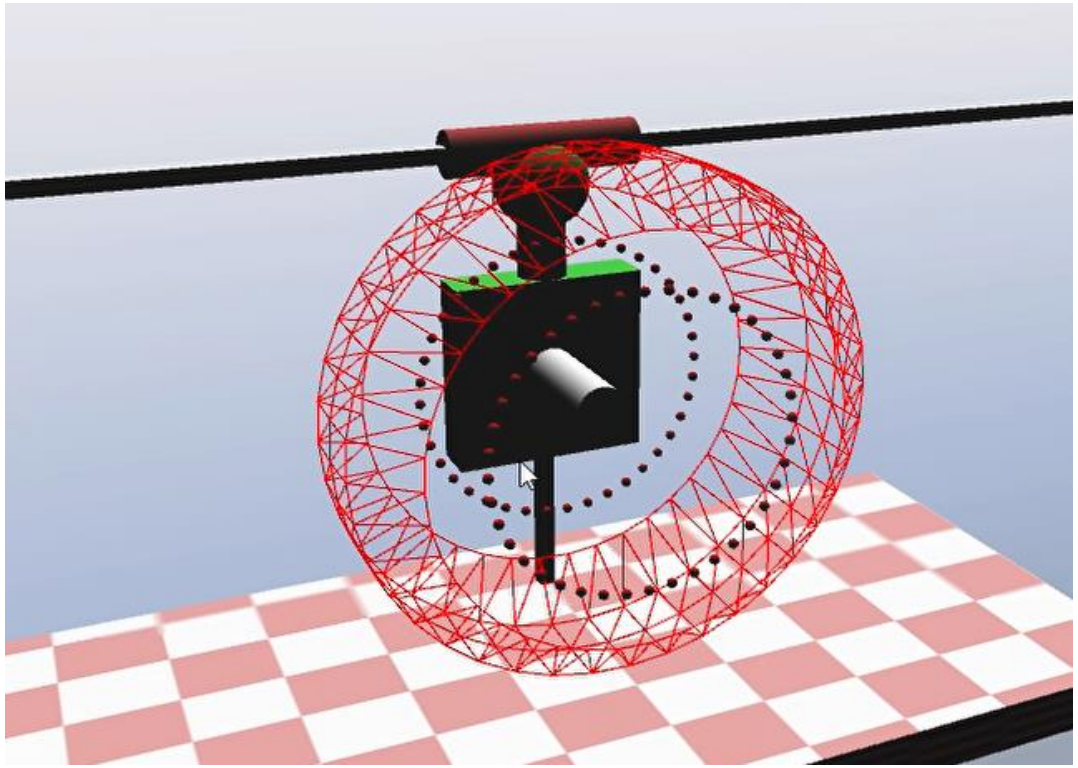




Simple Matlab realization

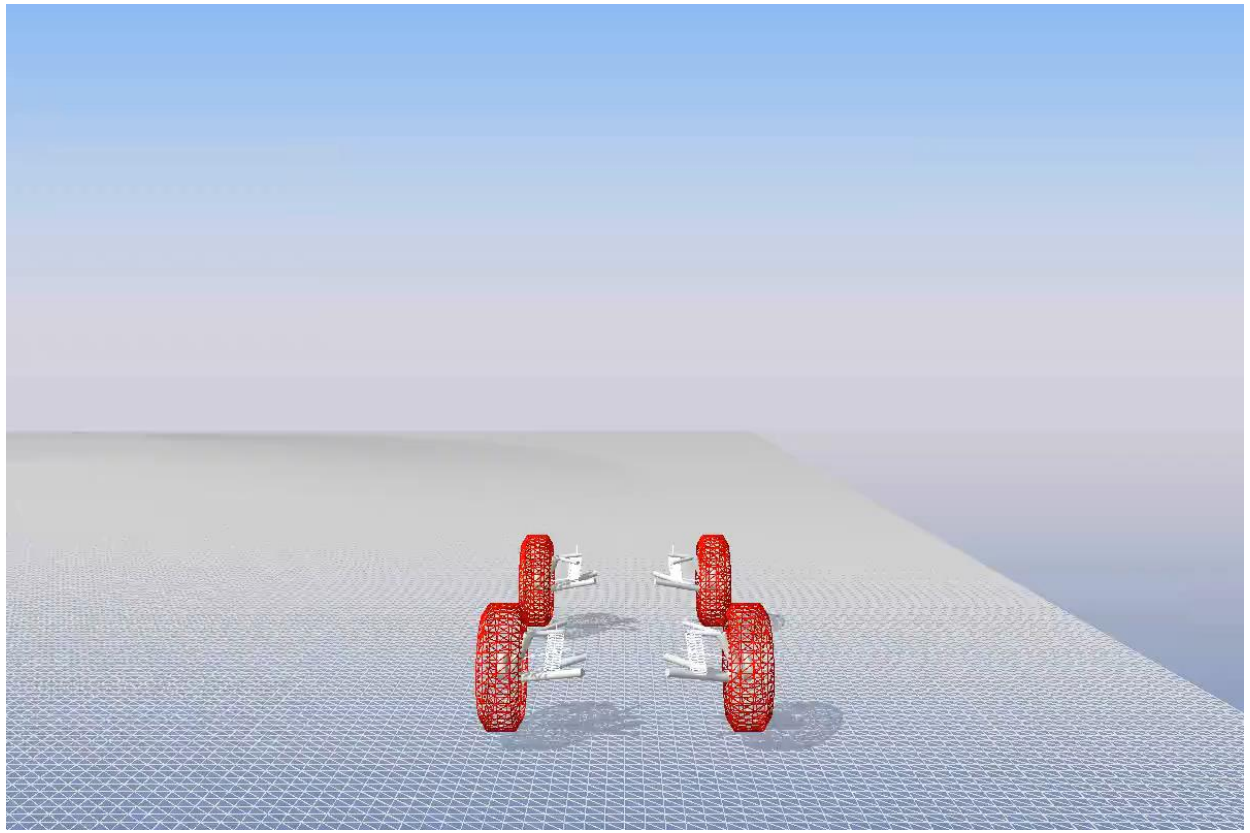
Chrono Realization (Benchmark simulations)



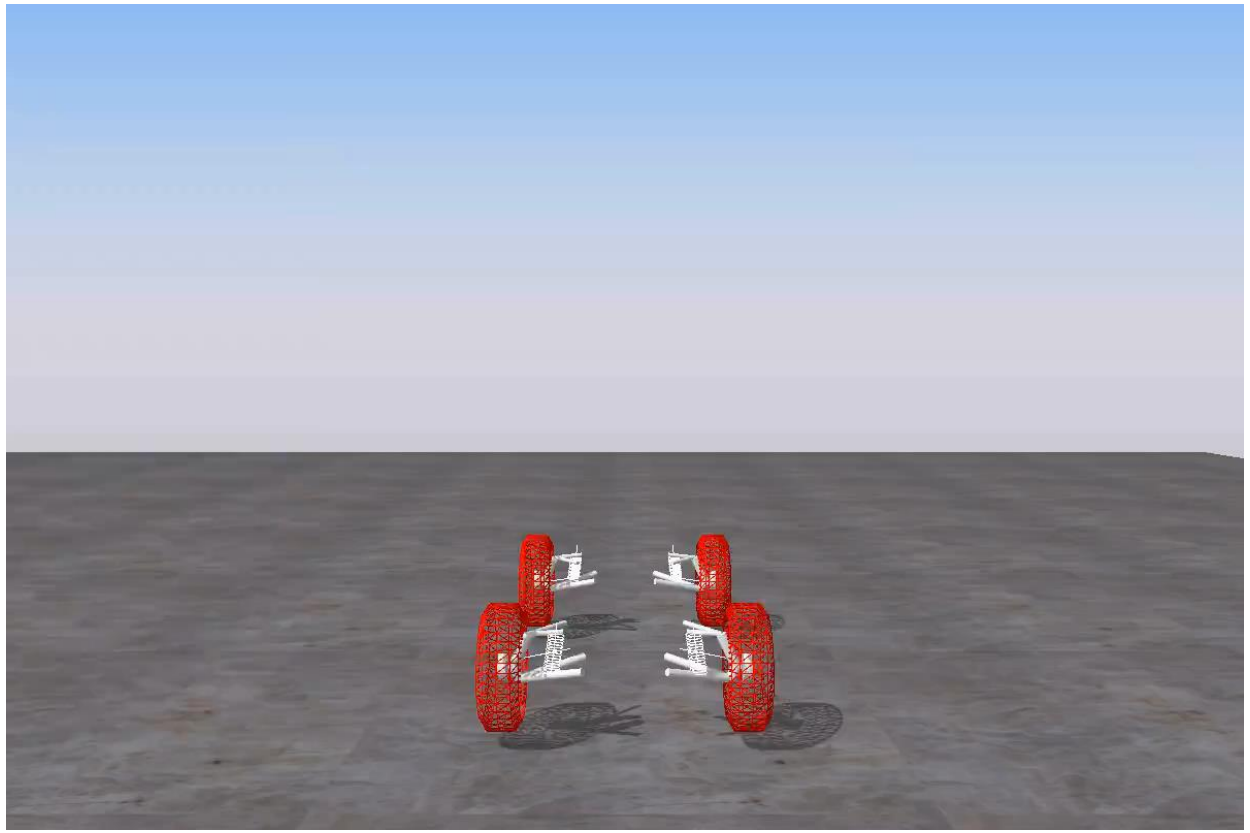


RTF = <4 and <10 for 607 translational DoFs (on not a powerful laptop)

Realization for Full Vehicle

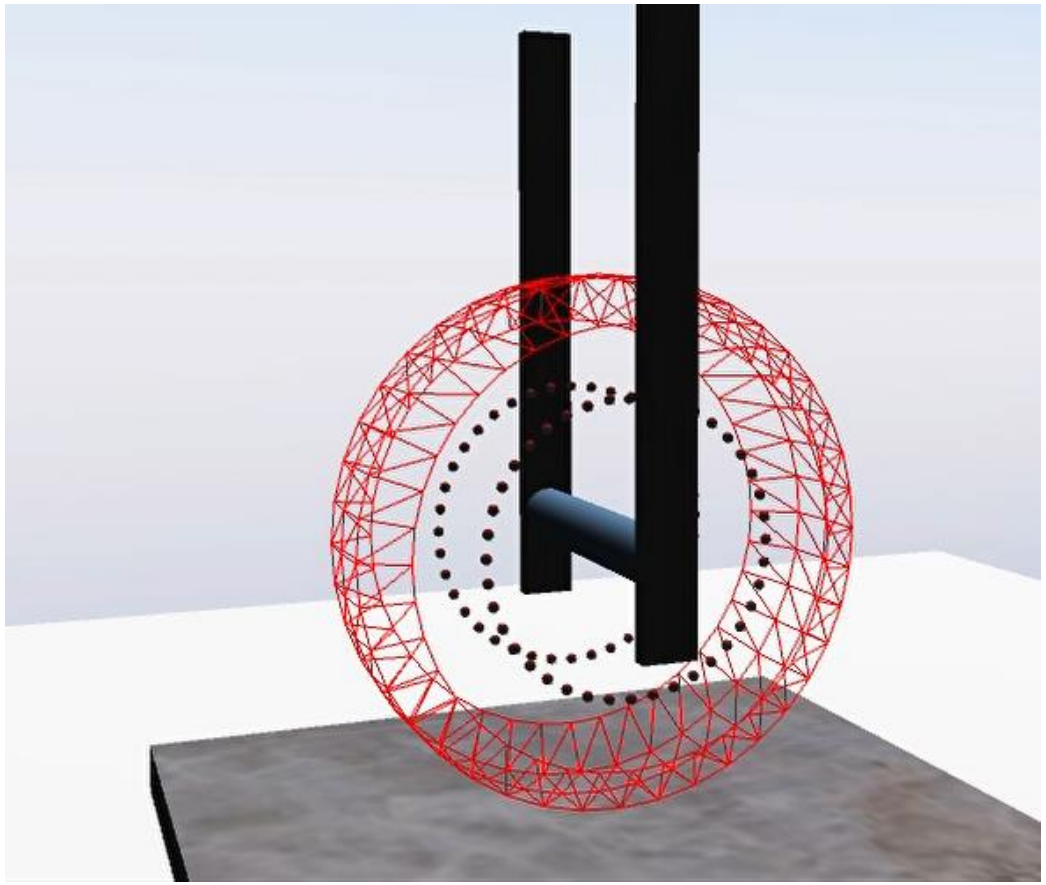


Deformable ground

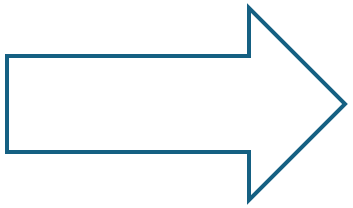


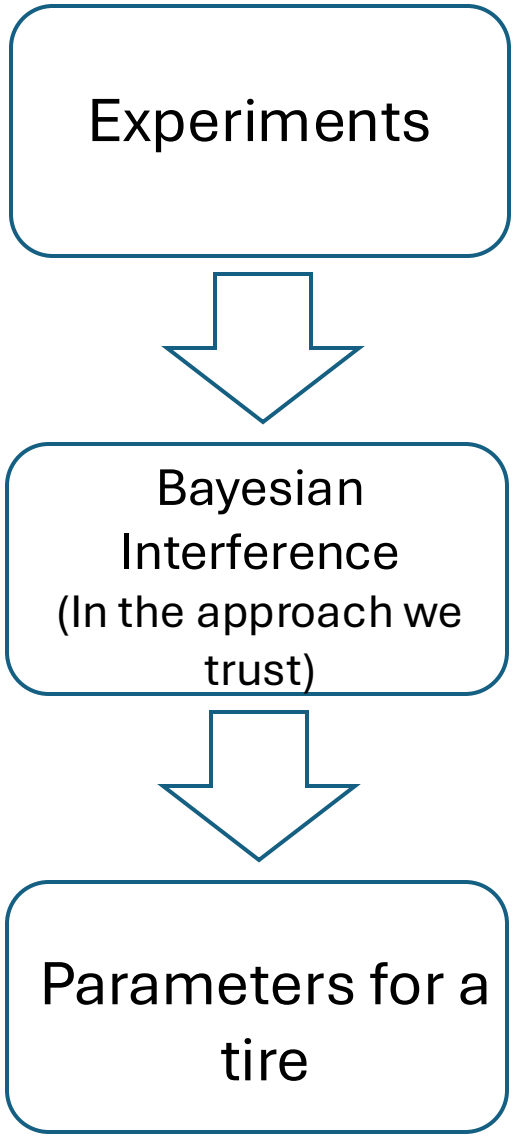
Rigid ground

Parameter identification & Tire tests (provided by Nokian Tyres) (current work)



Torsional tests (model)





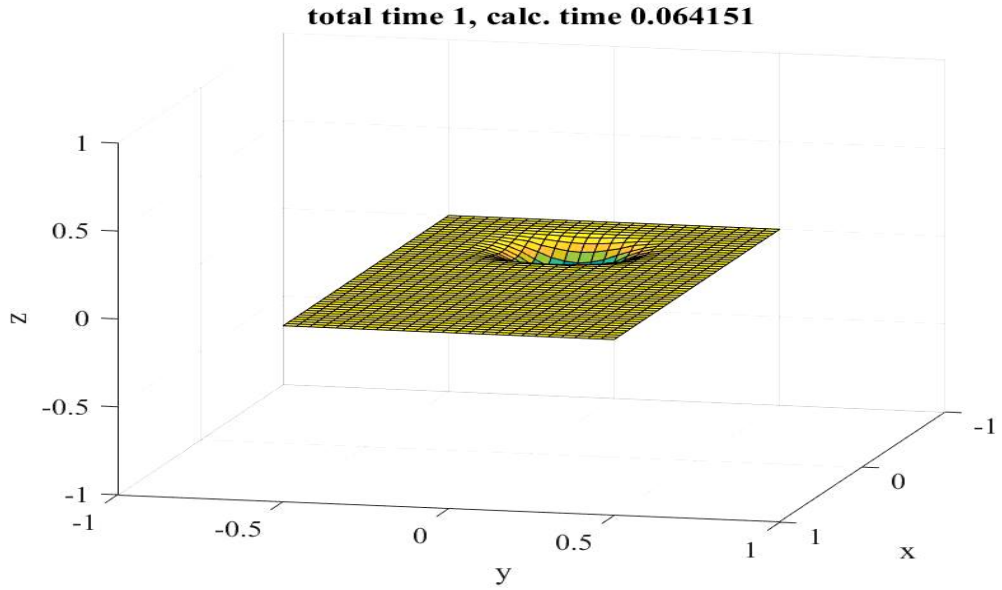
Future (soil experiments (provided by Roadmasters)

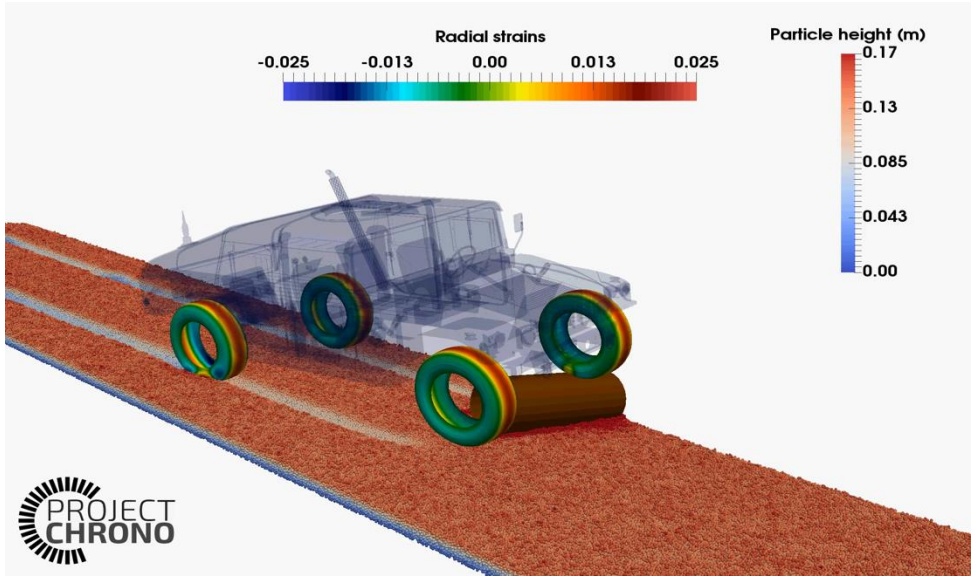
Experiments with soil

Parameters for a soil

New Matlab concept

Well-checked soil model





Special thanks again to our collaboration teams from:

- **Nokian Tyres**
- **West Coast Road Masters Oy**

Used pictures from

- M. Brennensthul et al. (2017/2024)
- F. Farroni et al. (2018)
- S. Tarkowski et al. (2022)
- A. Gallein et al. (2007)
- V. S. Swammy et al. (2023)
- H. M. Unjhawala et al. (2023)
- Chrono: An Open Source Framework for the Physics-Based Simulation of Dynamic Systems. http://projectchrono.org. Accessed: 2024-12-12.

Thank you