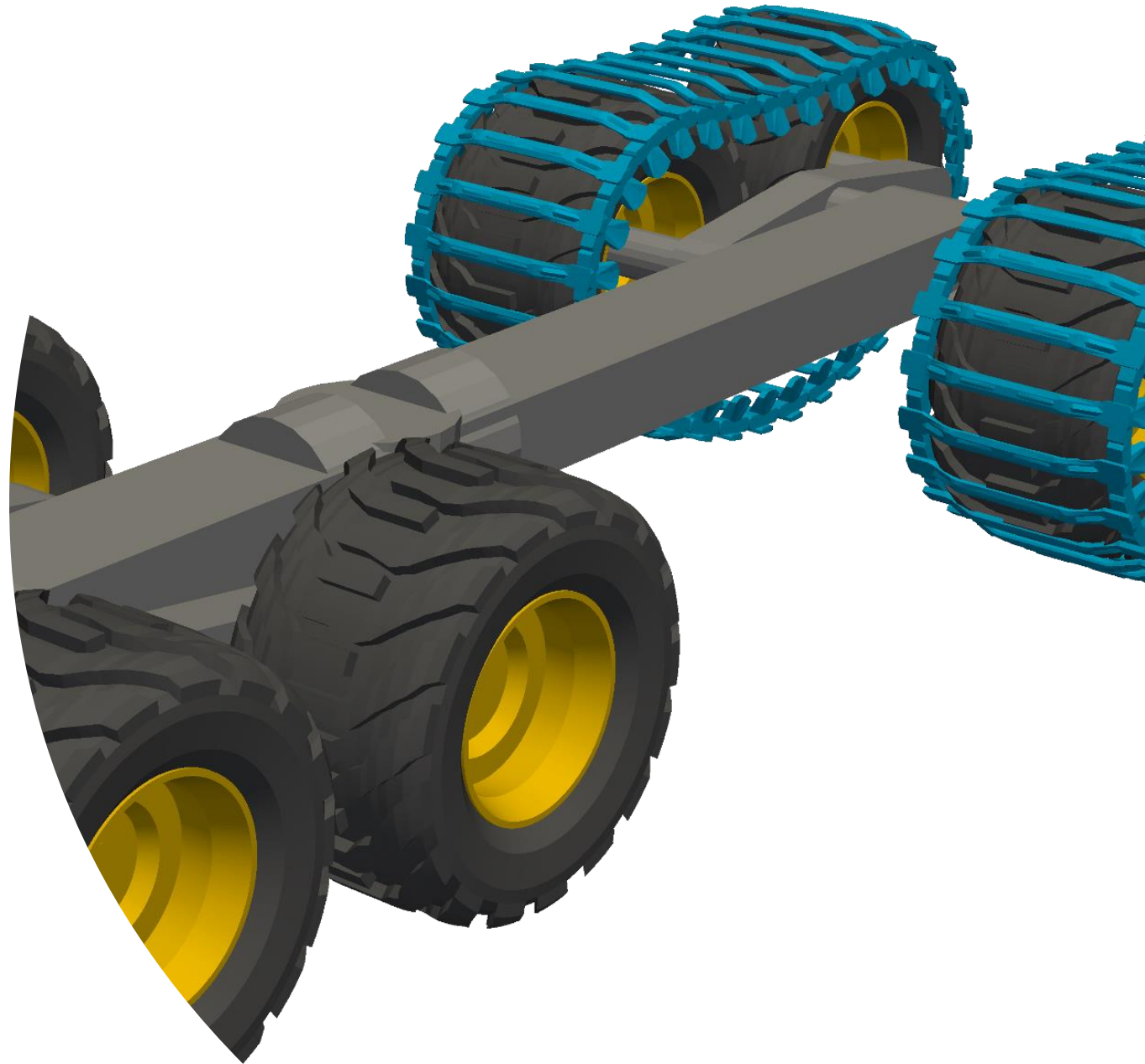


VieteriSim – modular terramechanics simulator

Sampo Kulju, Jari Ala-Ilomäki



Terramechanics simulator and Integration Soil Contact Model (ISCM)

- Computational model and the simulator was developed for computation of rut depths and rolling resistance values of vehicles moving on deformable terrain
- Extension of Soil Contact Model (SCM) [1]
 - Pressure-sinkage relationship
- Modular
 - Vehicles with wheels and tracks
 - Pressure-sinkage relationship can be freely set by a user, according to a function or a data set

1. B. Schäfer et al., *Planetary rover mobility simulation on soft and uneven terrain*, Vehicle System Dynamics 48, 2010

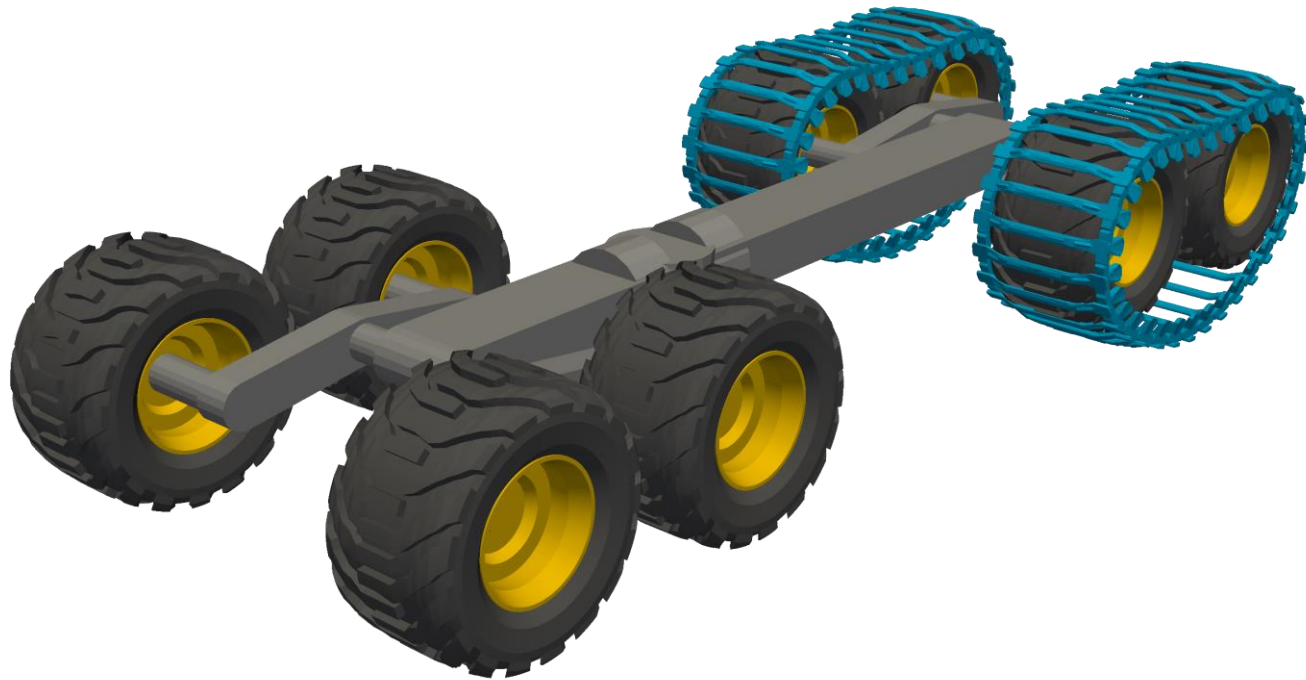
Define and build a vehicle

- Wheels
 - Rim and tyre
- Bogie
 - Geometry and turning angles
 - Tracks (optional)
- Sections of a vehicle geometry with mass



Vehicle examples

Forest machine, forwarder

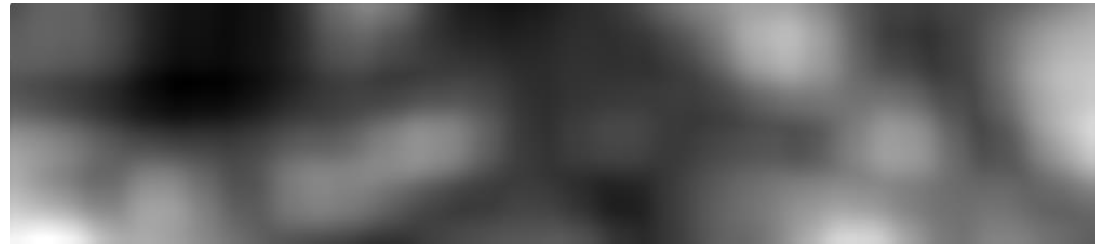
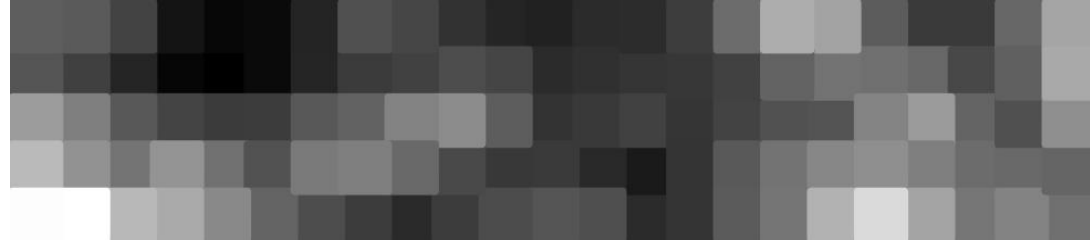


Combine harvester



Define and build terrain

- Topography
 - Digital Elevation Map (DEM)
 - Functions
- Rigid objects
 - Stumps and rocks
- Pressure-sinkage relationship
 - Experimental data set, such as penetrometer measurements
 - Functions

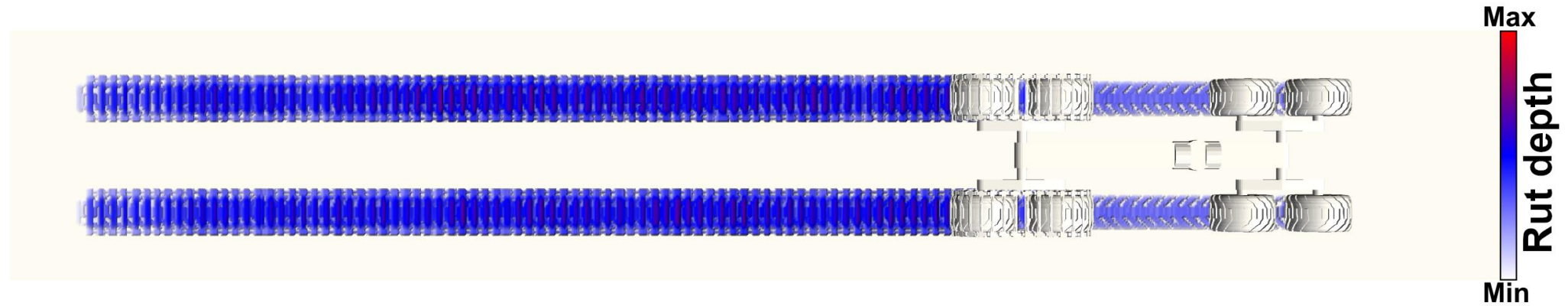


Computation

- Recognize the contact area for each wheel and track shoe
- Numerical integration of pressure over the contact area → force vectors
- Computation of the total force and torques
- Search the equilibrium state of the vehicle
- When the equilibrium state is found
 - Footprints of wheels and tracks to the terrain surface
 - Calculate the rolling resistance coefficient
 - Shift the vehicle to the next location

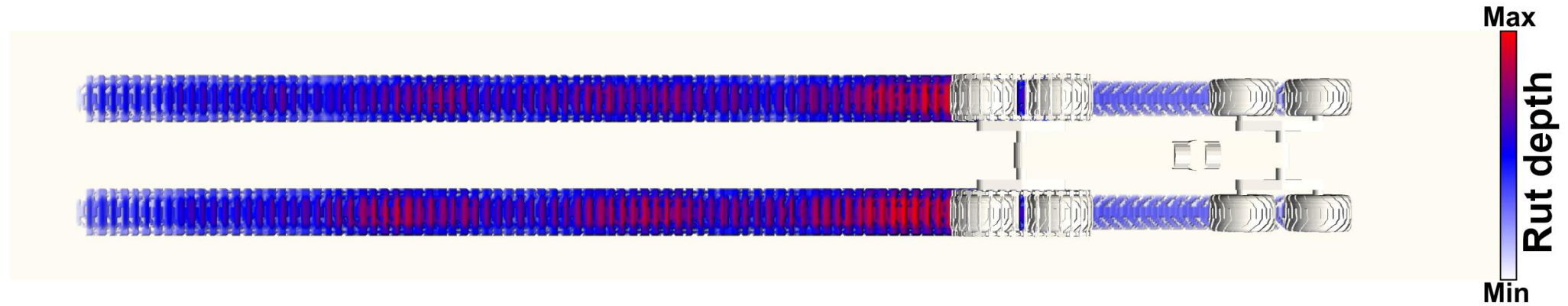
Rut depth examples

- Pressure-sinkage relationship is same for the whole area, flat surface



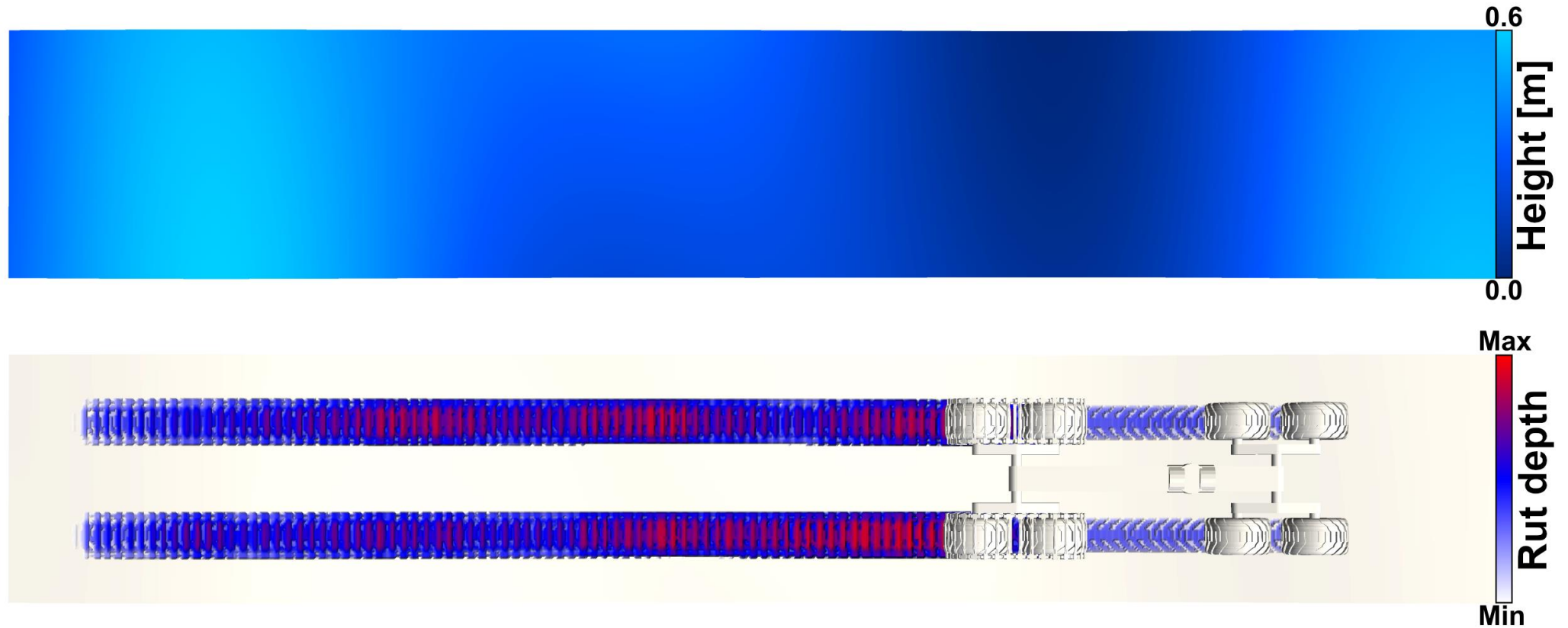
Rut depth examples

- Pressure-sinkage relationship with softer spots on the route, flat surface



Rut depth examples

- Pressure-sinkage relationship with softer spots on the route, surface with height variation



Conclusions

- Pros:
 - Pressure-sinkage relationship can be set flexibly
 - Computation and search of the equilibrium state is based on classical mechanics
- Cons:
 - Suitable only for slow moving vehicles, no dynamics
 - Computationally heavy

Thank you!



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