Technische Universität Braunschweig

Institut für mobile Maschinen und Nutzfahrzeuge

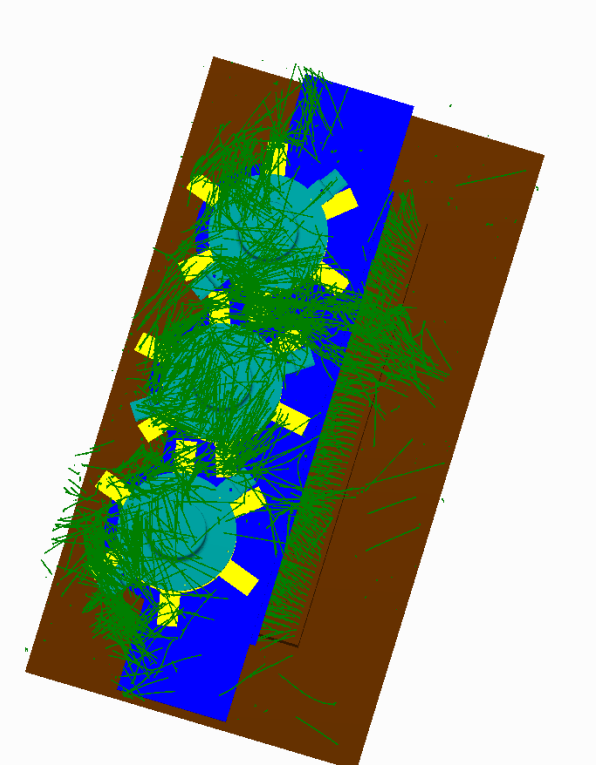
Discrete Element Method – Project excerpt

Discrete Element Method applications

The Discrete Element Method (DEM) is used to model

- conveying
- cutting
- mixing
- and digging processes

in agricultural and construction machinery.



The aim of the DEM simulation is to investigate interactions between tools and stalks, soils or other agricultural materials independently from, growing stage of plants, test machines, weather and further external factors.

In addition the understanding of various agricultural processes can be improved as a basis for future developments.

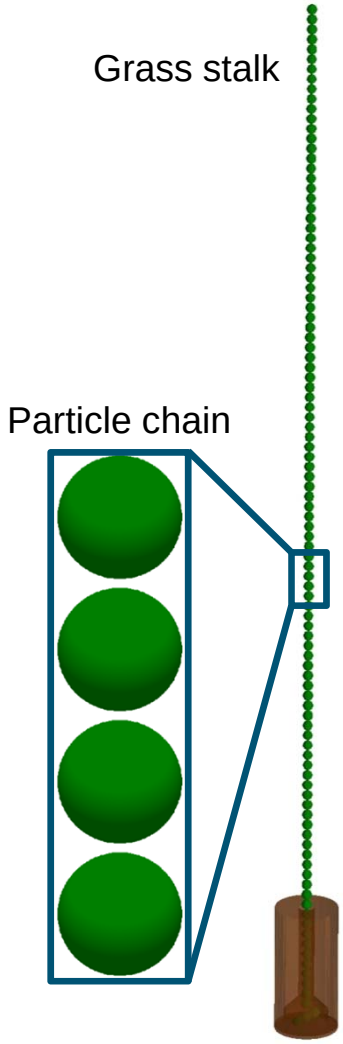
DEM simulation of a mowing process

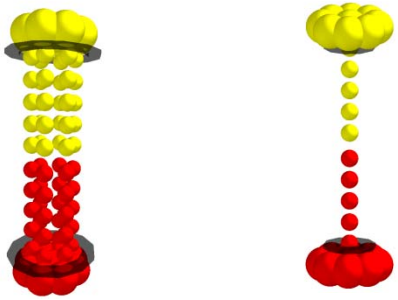
The mowing process of a rotary mower was modelled with the DEM.

The model includes:

- Grass stalks consisting of single particles
- Particles connected by flexible bonds
- Geometry of cutting tools

Additionally a multi-body-coupling simulation was implemented to get realistic cutting blade motions.





Ring structure Chain structure

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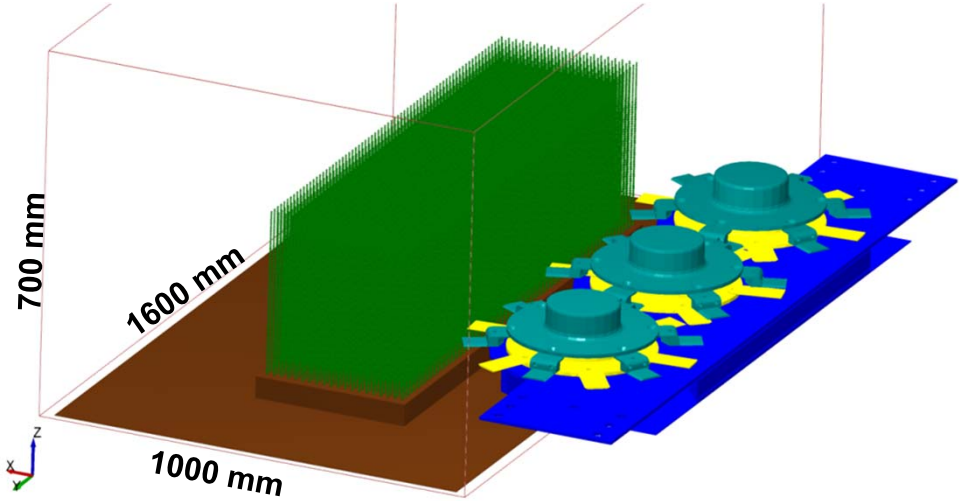
B.Sc. Florian Schramm

DEM simulation of a mowing process

The mower bar is equipped with three mowing units and each unit consists of two cutting discs.

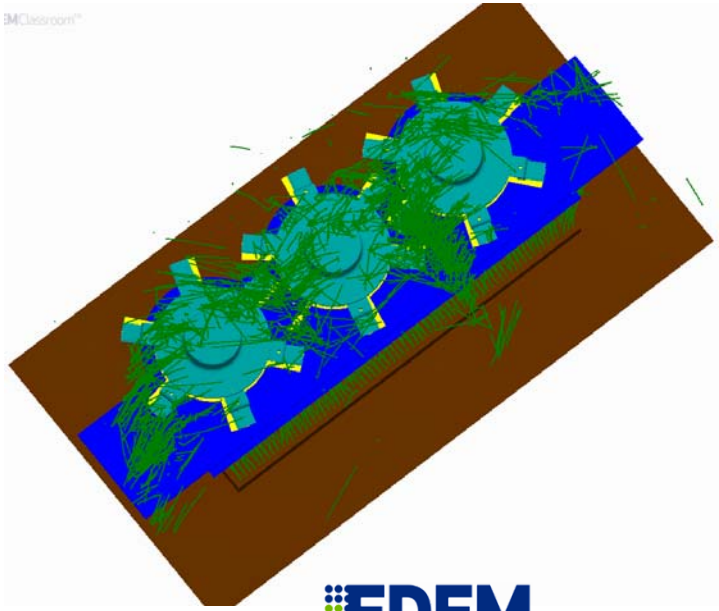
Density 25000 stalks per m²

Grass field



Example : Crop flow simulation for a mower with three cutting unis:

- 6 blades on each disc
- Upper blade speed 20 m/s
- Lower blade speed 50 m/s
- Counter rotating discs



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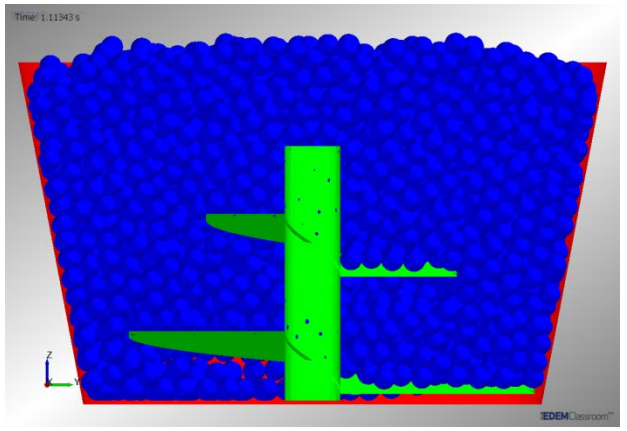
DEM simulation of a mixing process in a mixing wagon

The mixing process was modelled in order to get a detailed understanding of the mixing process and its main influencing factors.

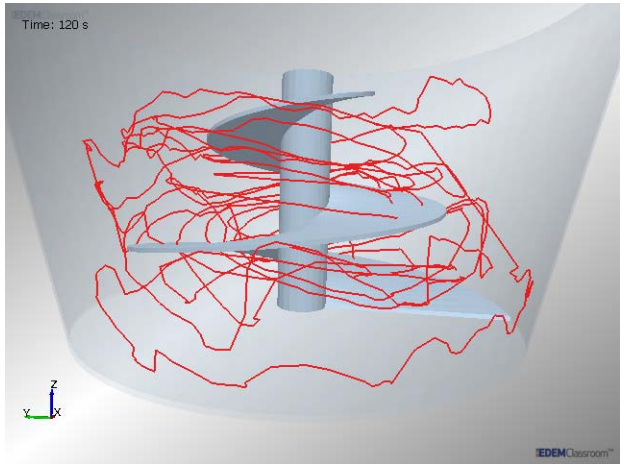
The model includes:

- Fodder consisting of one or more particles
- Mixing screw

For parameterisation and validation angle of response tests were carried out with silage.



Mixing wagon filled with particles



Trajectory of a fodder particle in the mixing wagon

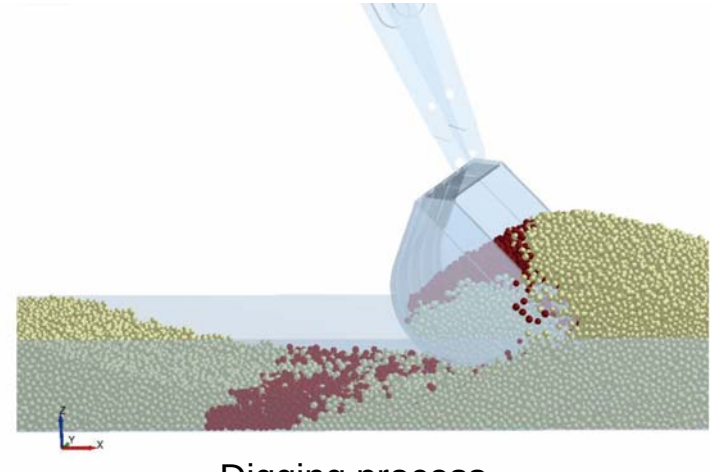
DEM simulation of a digging process

With the DEM the digging process of an excavator modelled.

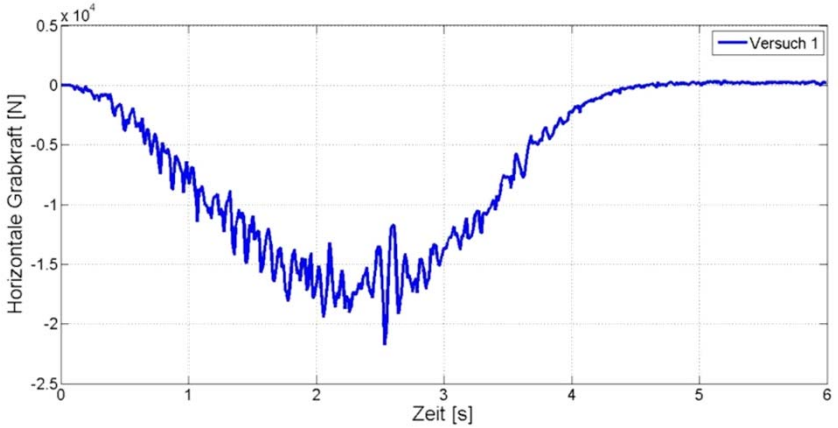
The model includes:

- Soil with different size distribution
- Particles consisting of one or more spheres
- Excavator bucket

For soil parameterisation literature data was used to specify interaction properties between soil and soil-tool-contacts.

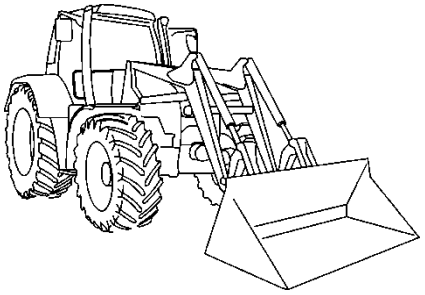


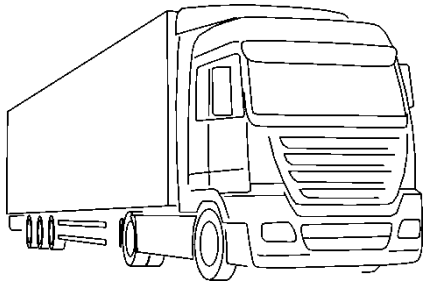
Digging process

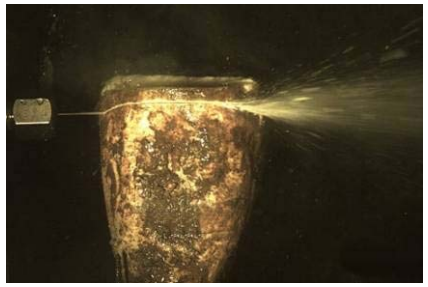


Pressure distribution in the bucket due to the digging process

Thank you for your attention!







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