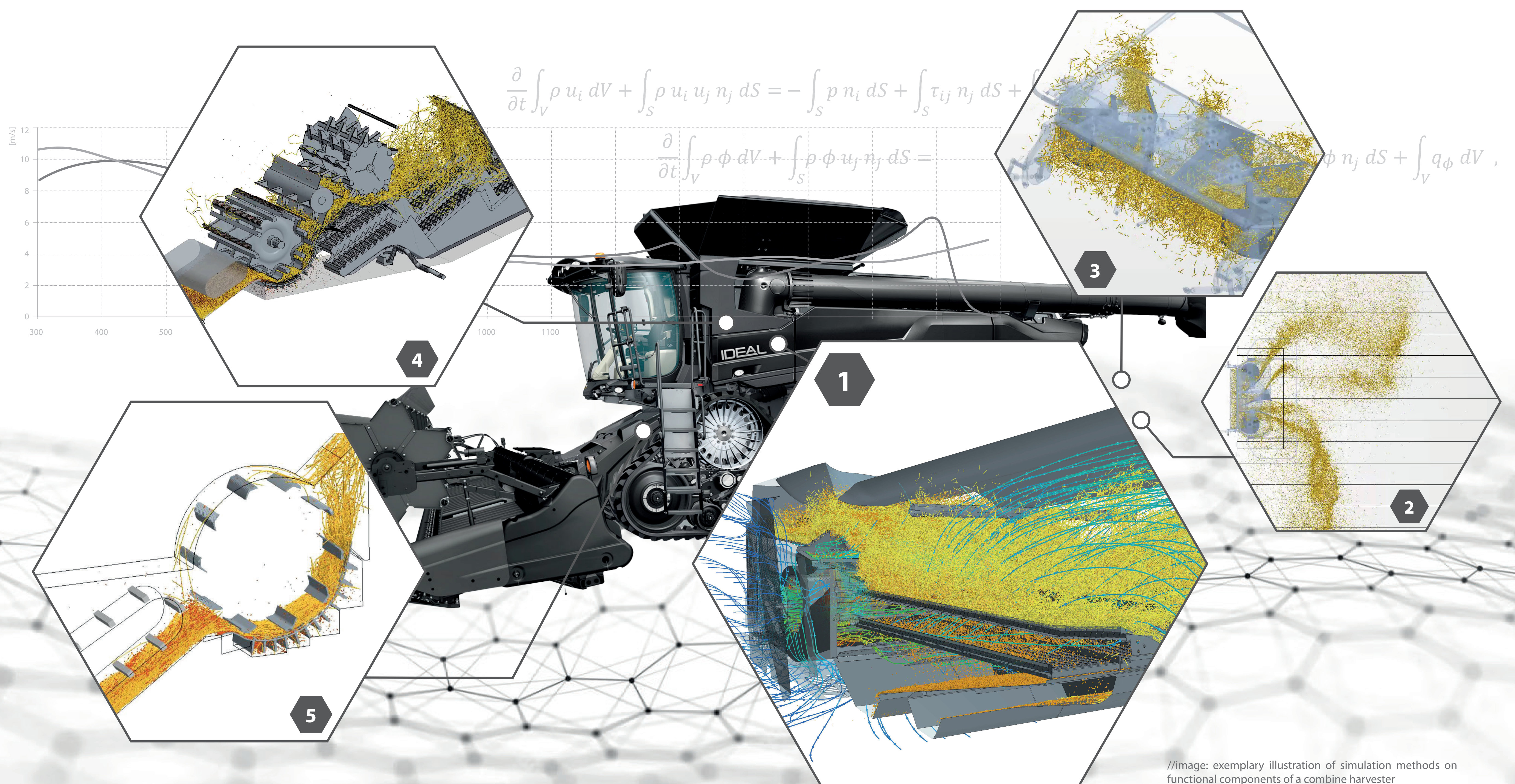




CFD-DEM SIMULATION

SIMULATION OF MATERIAL FLOW AND PROCESSING IN COMBINE HARVESTERS



//Image: exemplary illustration of simulation methods on functional components of a combine harvester

COUPLED CFD-DEM SIMULATION

Numerical computations are performed with CFD (Computational Fluid Dynamics), DEM (Discrete Element Method) or a coupled approach of both. For example, coupled CFD-DEM simulations are used to investigate material separation by vibro-fluidization in combine harvester cleaning devices: grain is separated from chaff and straw by oscillating sieves supported by air flow (Fig. 1). Further, for the residue management (chopping and spreading) coupled CFD-DEM simulations are performed in order to explore particle trajectories and material distribution on the field (Fig. 2 and Fig. 3). Pure DEM simulations using flexible and breakable fiber particles are carried out in order to understand and optimize material flow and processing in the threshing unit and grain-straw separation units (Fig. 4 and Fig. 5).

OBJECTIVES

- Development of valid and efficient numerical tools in order to predict material flow and material processing in harvesting machinery
- Incorporation of typical properties of biogenic particles (e.g. variability of size and shape, moisture)
- Reduction of the numerical effort to an acceptable level
- Acceleration of the development and test cycle of new functional machine components
- Enabling of virtual tests of special influences, e.g. side hill conditions; reduction of time for lab and field testing (which are costly, hard to reproduce and seasonal)
- Create data for training of AI tools

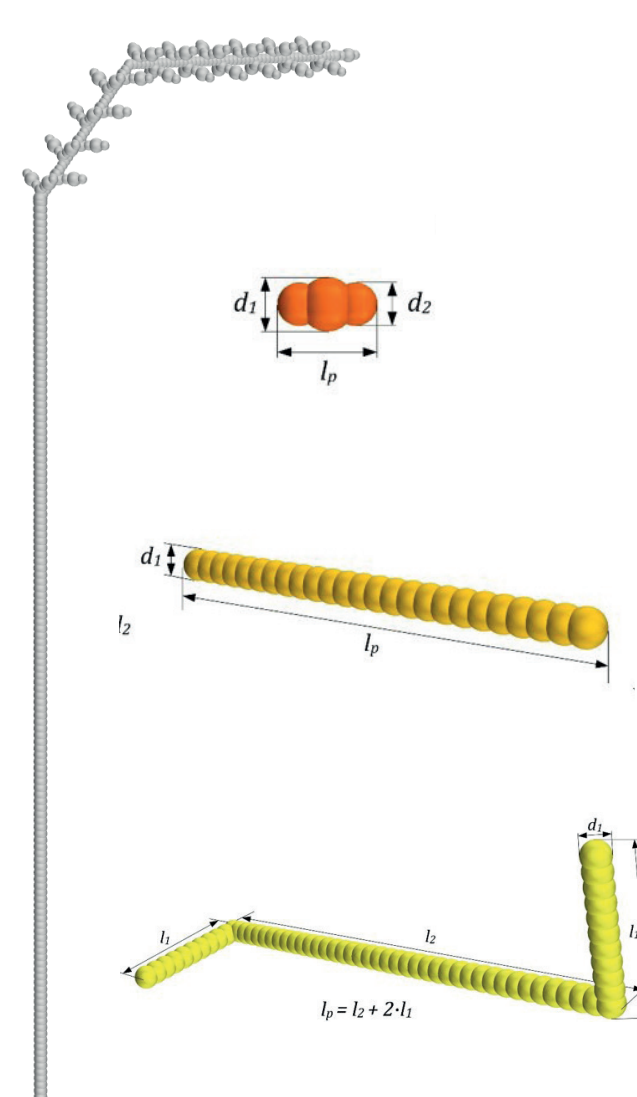
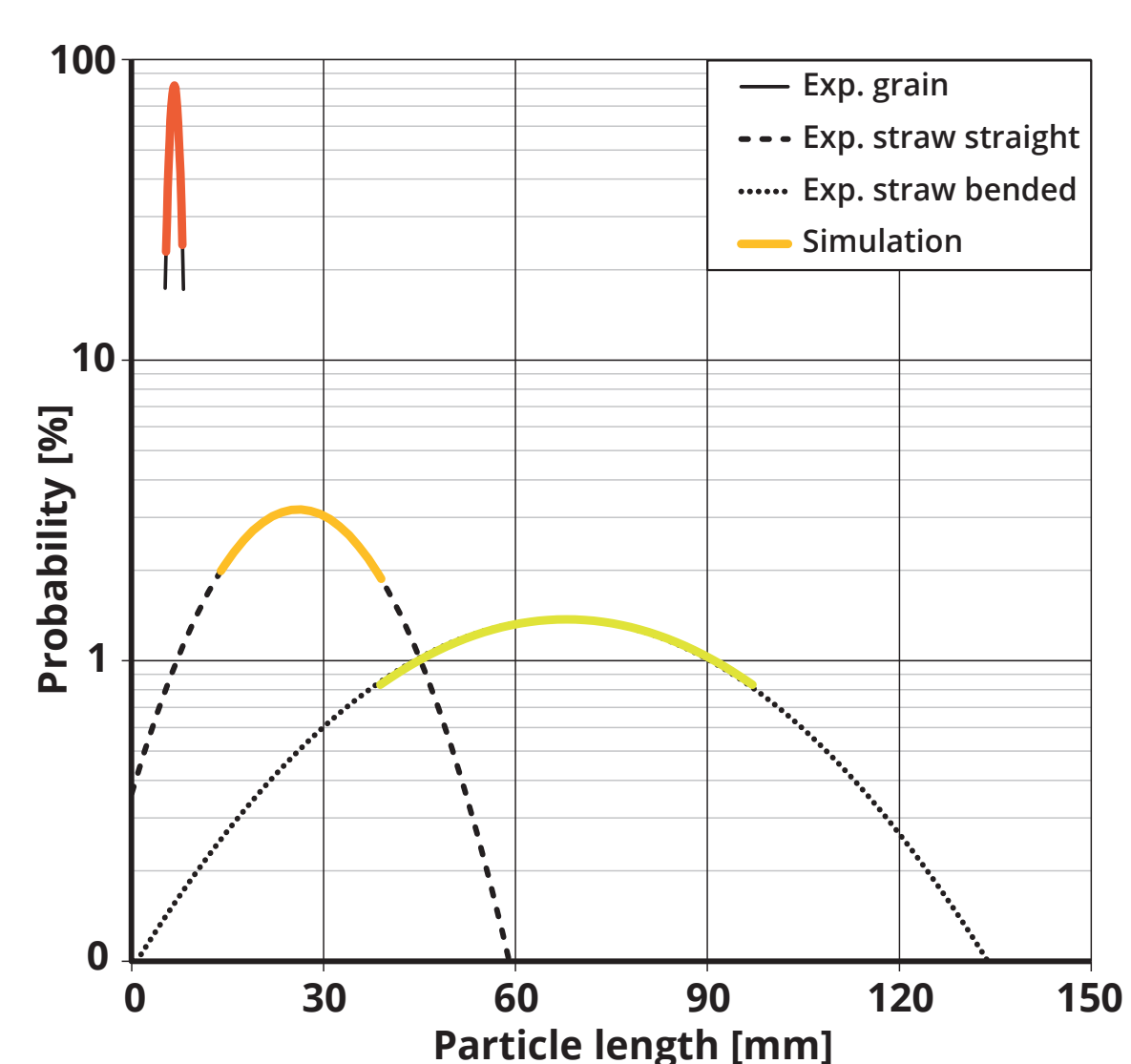
CALIBRATION AND VALIDATION

- Extensive preliminary experimental and numerical investigations to characterize the particle properties and interactions
- Intensive dependency studies between particle properties, bulk properties, process parameters and target variables to enable an efficient creation of the simulation model
- Strategic approach: Preliminary investigations and sensitivity studies mostly in downscaled or simplified models, model complexity increased stepwise
- Experimental validation takes place at various stages of model development
- Challenging: specific characteristics of biogenic material (variety of crops, scattering properties, influence of moisture, maturity etc.)

ANALYSIS



MODELING



VALIDATION

