The Extended Discrete Element Method (XDEM) for Multi-Physics Applications

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• Introduction
• Features and Benefits
• Thermal Conversion of Packed Beds
• Conclusions
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Extended Discrete Element Method (XDEM):

- based on the classical Discrete Element Method (DEM) to describe motion of granular materials (discrete phase)
- extended by
  - thermodynamics for particles
  - an interface to Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA)
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Benefits

• Appropriate solution strategy for discrete and continuous phase
• High resolution of both discrete and continuous phase
• No empirical correlations
• No expensive experiments, sometimes even not feasible
• Retains individual inputs
• Common post-processing preferred, although individual post-processing feasible

Combination of expert tools for maximum synergy
Applications

- Storage and transport of granular material
- Mining and its machinery
- Agriculture and its machinery
- Processing industry: Fluidised beds, fixed and moving bed reactors for
  - Drying
  - Thermal conversion (combustion, gasification)
  - Processing of raw materials
- Pharmaceutical industry e.g. coating, drug production
- Food industry (transport, coating, processing)
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Spatial and Temporal Temperature Distribution
Validation for a Single Particle

![Graph showing residual moisture mass fraction over time for measurements and predictions at 66% and 33% moisture content.](image-url)
Validation for a Packed Bed

![Graph showing moisture loss over time with predictions and experiments at different temperatures (T = 423 K and T = 408 K).]
Distribution of Porosity and Velocity
Distribution of Temperature and Humidity

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Conclusions

- XDEM as a novel and advanced simulation framework for multi-physics applications
- Efficient and flexible coupling to CFD/FEM solvers
  - Mechanical interaction
  - Heat/mass transfer
  - Drag forces
- High resolution of discrete and continuous phases
- No further modelling or assumptions
Thank you very much for your attention

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