Eulerian-Lagrangian momentum coupling between XDEM and OpenFOAM using preCICE

ECCOMAS - WWCM 2021

Xavier Besseron, Alban Rousset, Alice Peyraut, Bernhard Peters

Luxembourg XDEM Research Centre
http://luxdem.uni.lu/

UNIVERSITÉ DU LUXEMBOURG

Outline

Our goal

- Multi-physics coupling
- Eulerian-Lagrangian coupling

DEM+CFD Coupling

- OpenFOAM
- XDEM

Results

- CFD-DEM coupling on testcase

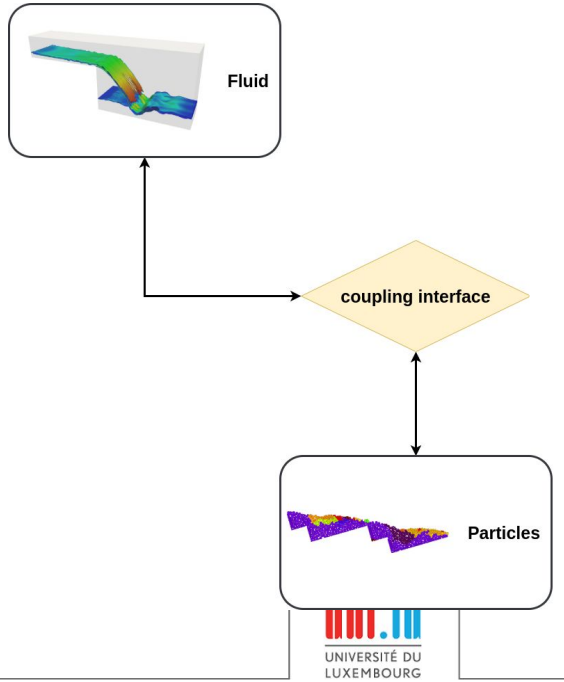
Conclusion

- Future Work

Multi-physics coupling

Our goal

- 2-way coupling DEM+CFD (with volume coupling)
  - *Fluid ⇔ Particles*



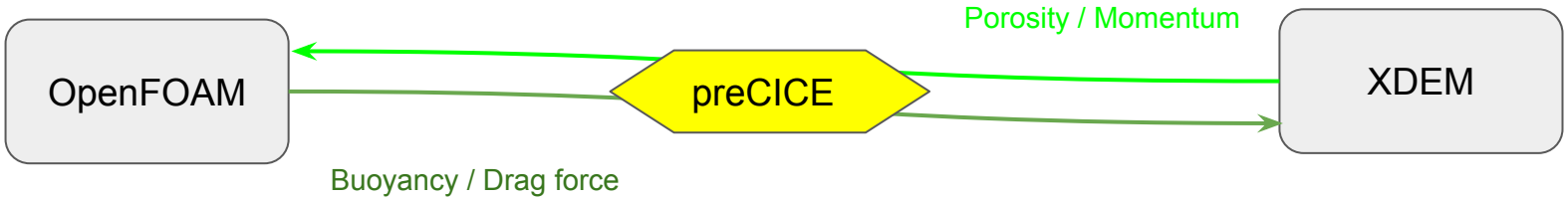
Coupling of 2 solvers

- CFD: OpenFOAM (interFoam)
- DEM: XDEM (Dynamic module)

UNIVERSITÉ DU LUXEMBOURG

DEM+CFD coupling

- Add porosity field
- Applied porosity with Darcy law (fvOptions)
- Support for volume coupling



- Coupling Interface
- Compute Porosity
- Compute Drag & Buoyancy force
- XDEM Adapter

OpenFOAM

Modifications for OpenFOAM

Solver: **interFoam**

- Add **porosity** field
- Applied porosity with **Darcy law** (fvOptions)

Adapter

- Support for **volume coupling** (thanks to PR#97 OF adapter https://precice.discourse.group/t/can-precice-be-used-for-volume-coupling/27/3)

Open questions

- Add porosity in the solver equation as a semi-implicit source

XDEM

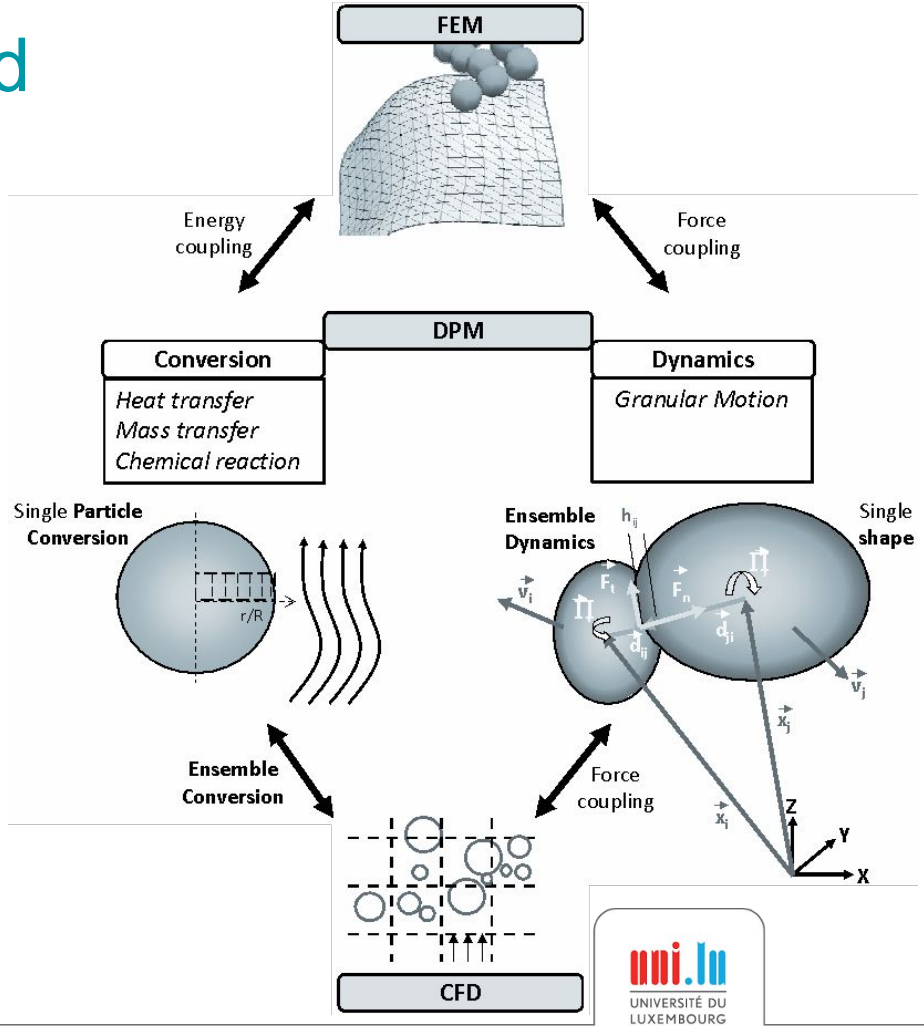
What is XDEM?

eXtended Discrete Element Method

Dynamics
- Force and torques
- Particle motion

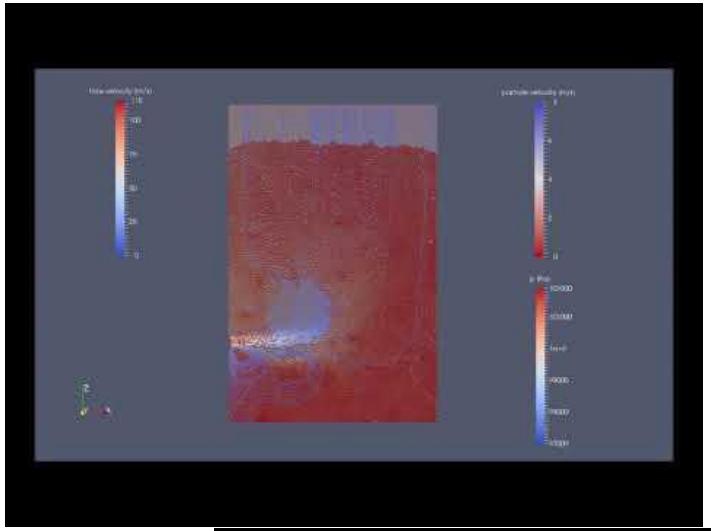
Conversion
- Heat and mass transfer
- Chemical reactions

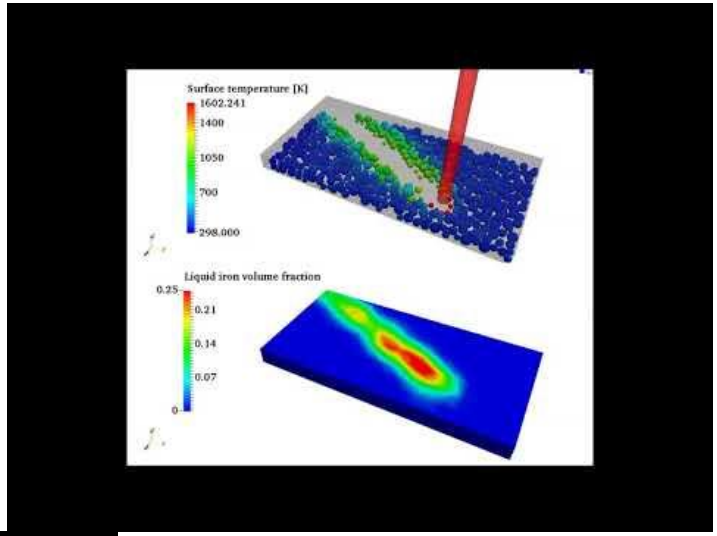
AD-Hoc Coupling with
- CFD: Foam-extend / OpenFOAM
- FEM: Diffpack



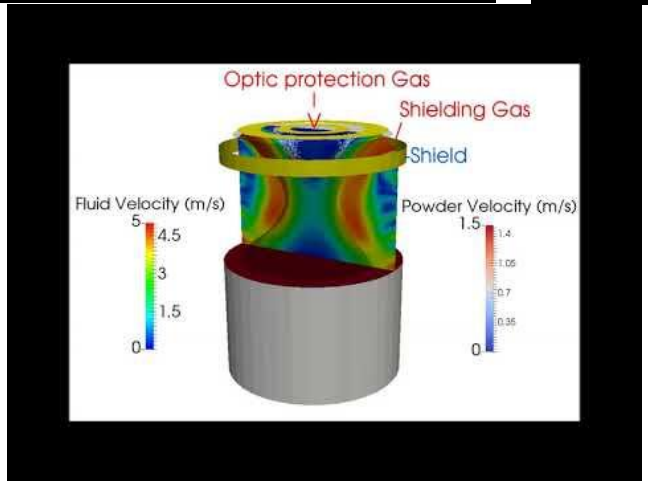
Examples

Formation of a Raceway in a Blast Furnace





Selective Laser Melting



Selective Laser Melting Powder dynamics

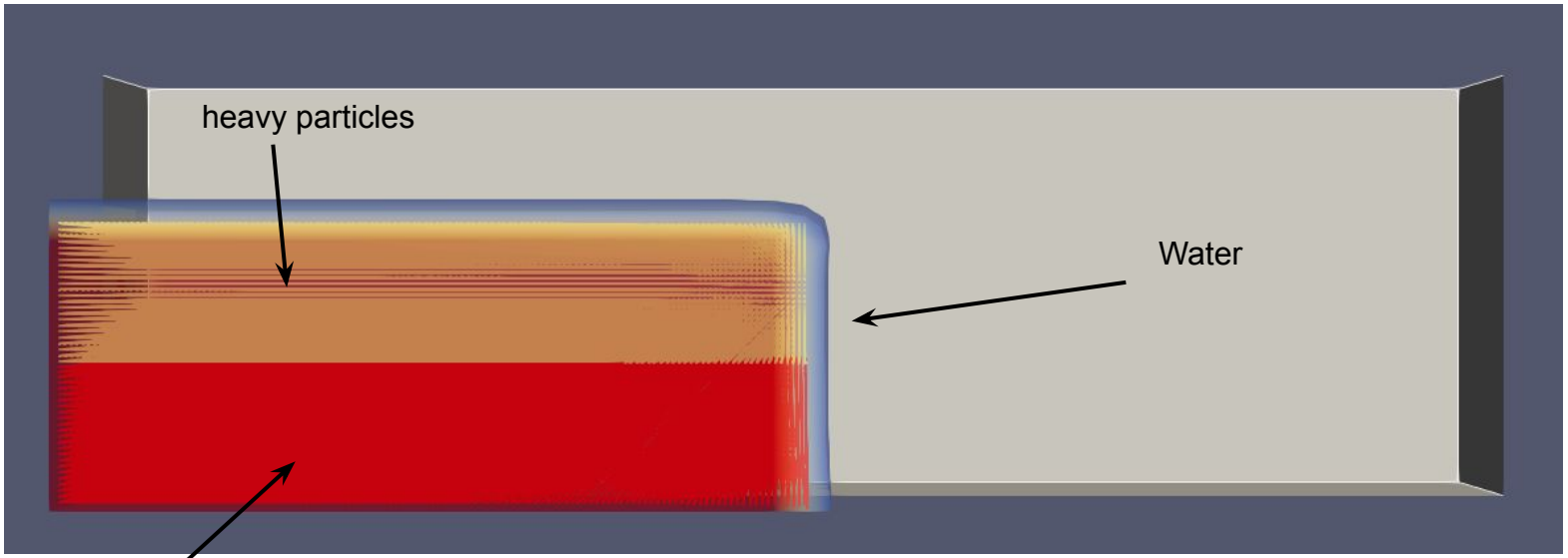
Creation of XDEM Adapter and interface coupling

Re-organize coupling functionalities into a coupling interface

- CFD Coupling interface for XDEM
  - Computation of **porosity**
  - Computation of **drag** and **buoyancy forces** (from fluid velocity)
  - Computation of **density** and **viscosity**
- Creation of **XDEM adapter** for preCICE

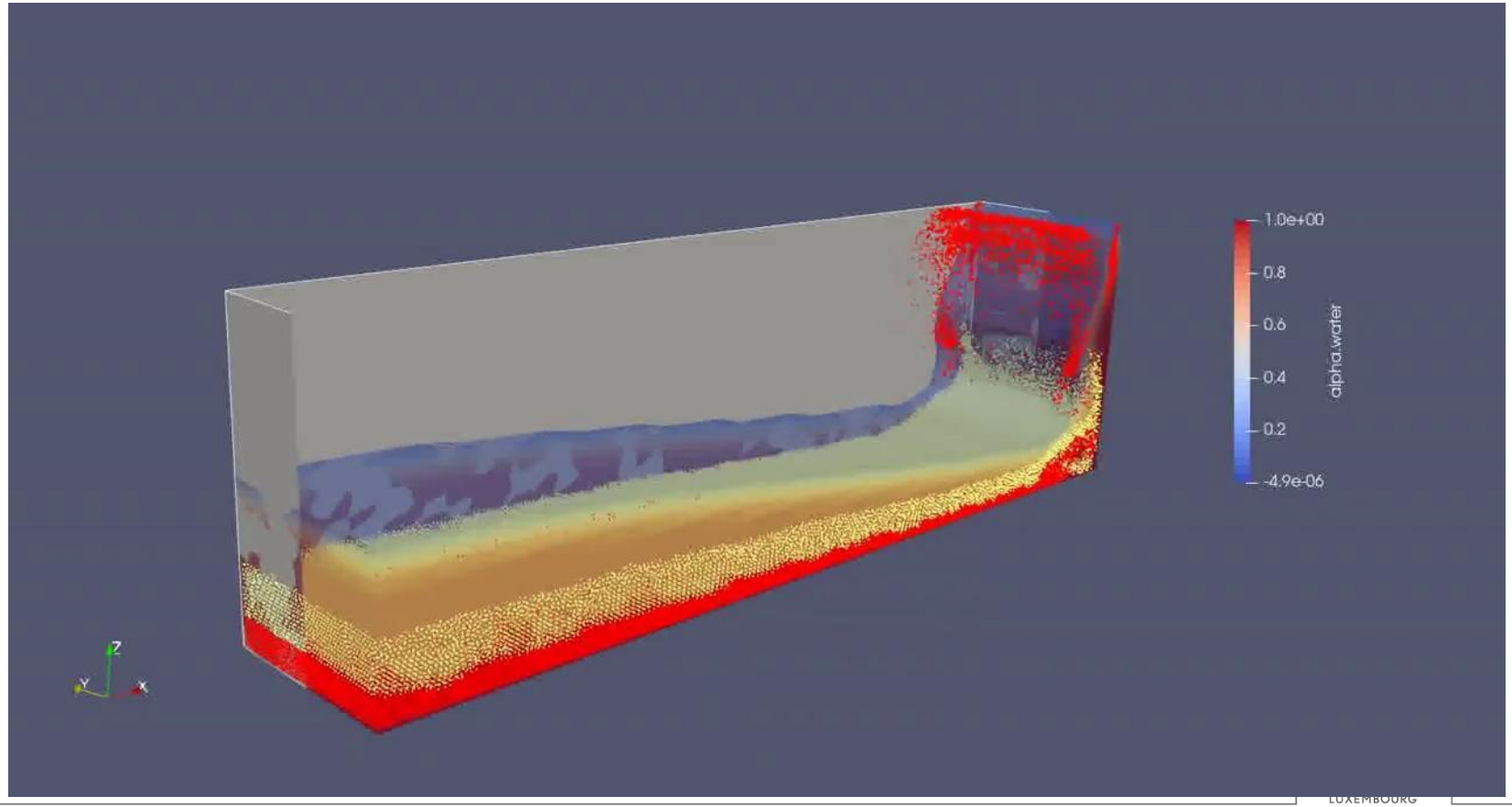
UNIVERSITÉ DU LUXEMBOURG

Testcase



Results

Results: coupling DEM+CFD



Conclusion

Preliminary results: CFD-DEM coupling

OpenFOAM Adapter

- Volume coupling (PR#97)

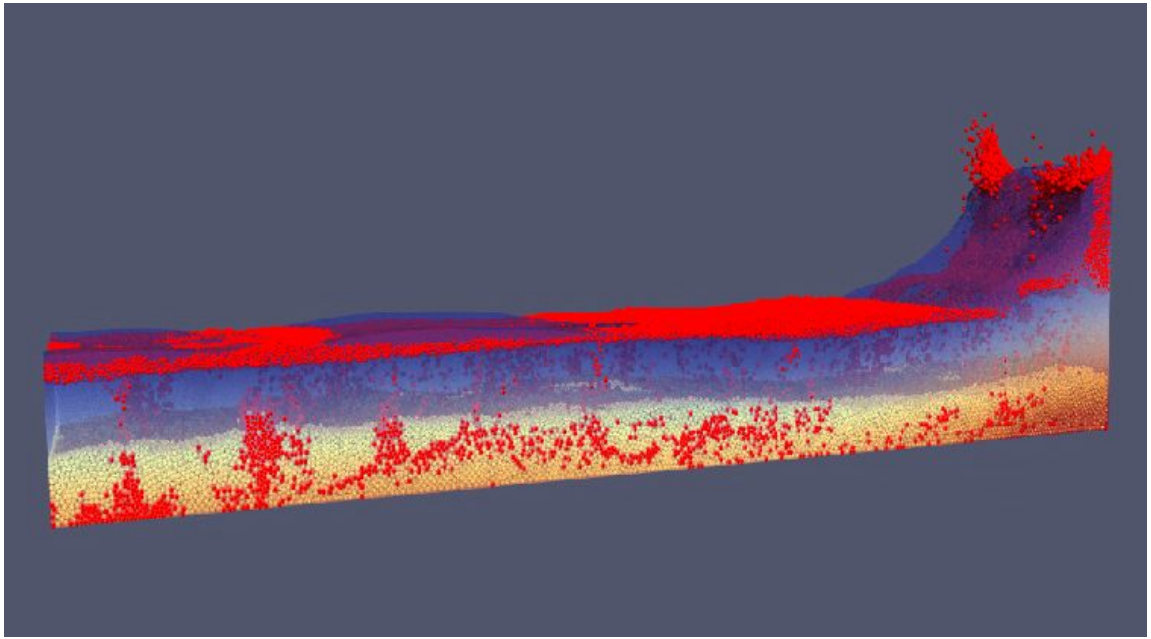
Coupling interface in XDEM

- DEM + CFD
- First step into preCICE coupling

Future work / Other issues

- Heat and mass transfer (DEM-CFD) (prototype in progress)
- Compare results between preCICE and our own coupling

Thank you for your attention!



Luxembourg XDEM Research Centre http://luxdem.uni.lu/

Supported by the Luxembourg National Research Fund (Project: 13318107)

Luxembourg National Research Fund

Xavier Besseron, Alban Rousset, Alice Peyraut, Bernhard Peters

uni.lu UNIVERSITÉ DU LUXEMBOURG