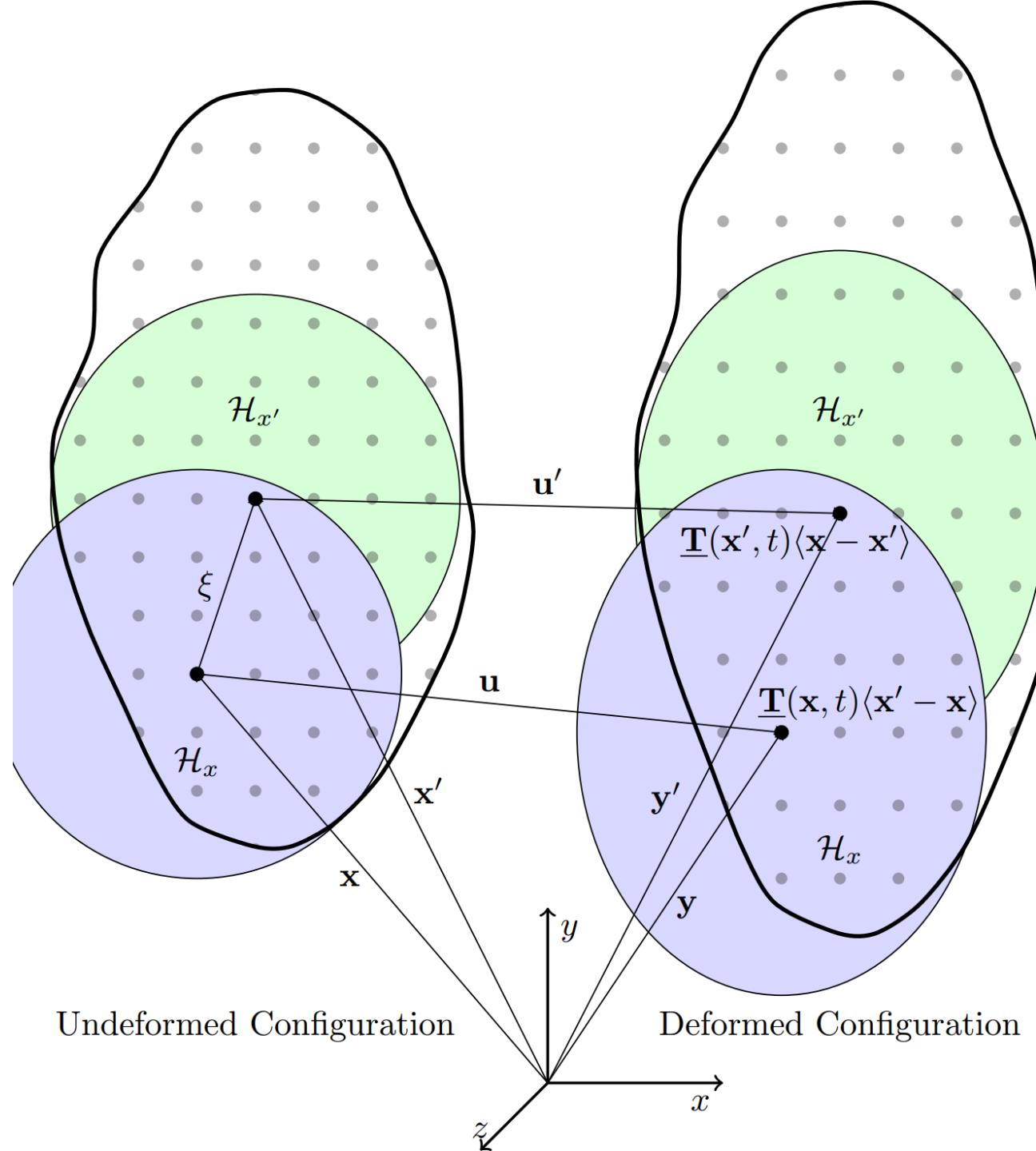


Non-local structural mechanics and Peridynamics

Prof. Dr.-Ing. Christian Willberg^{id}

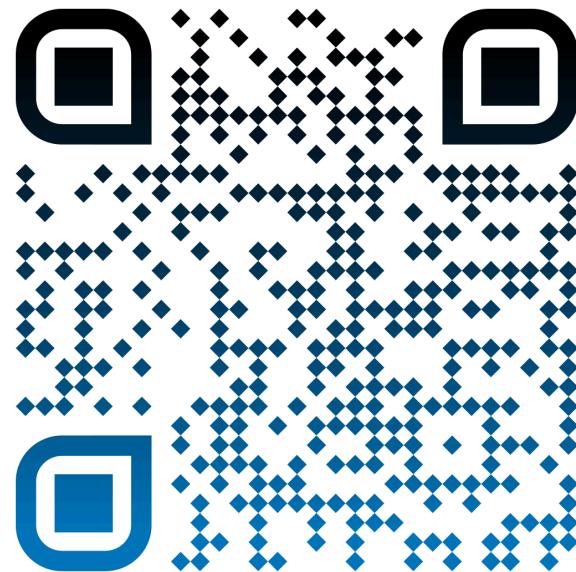
Magdeburg-Stendal university of applied sciences

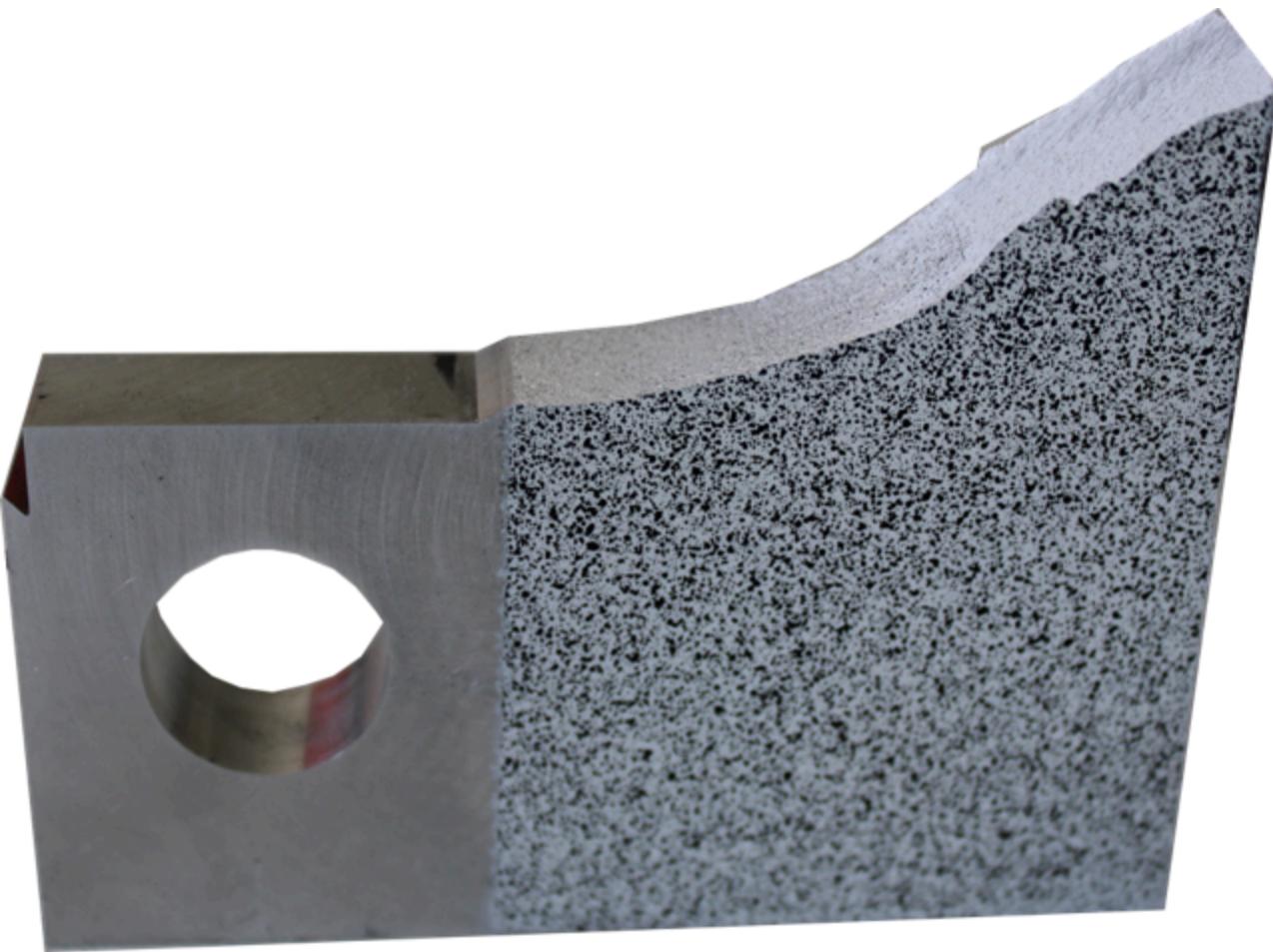
Kontakt: christian.willberg@h2.de

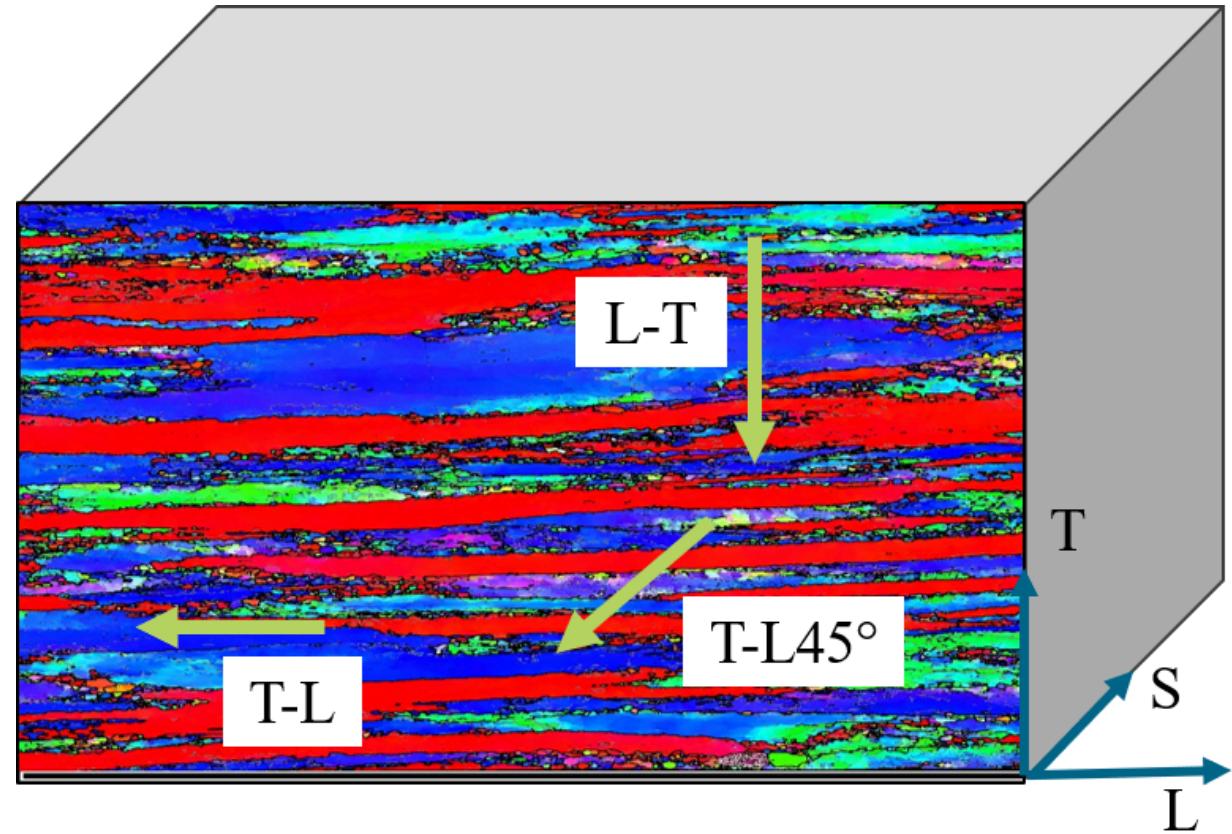
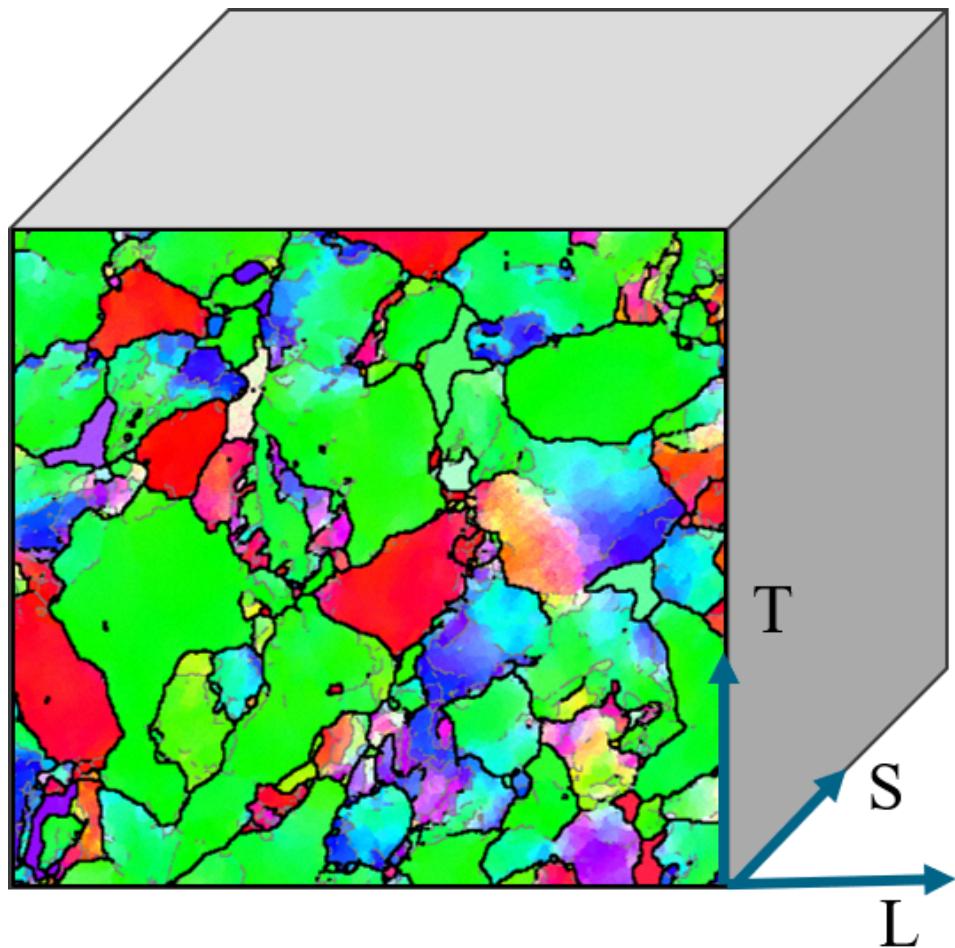


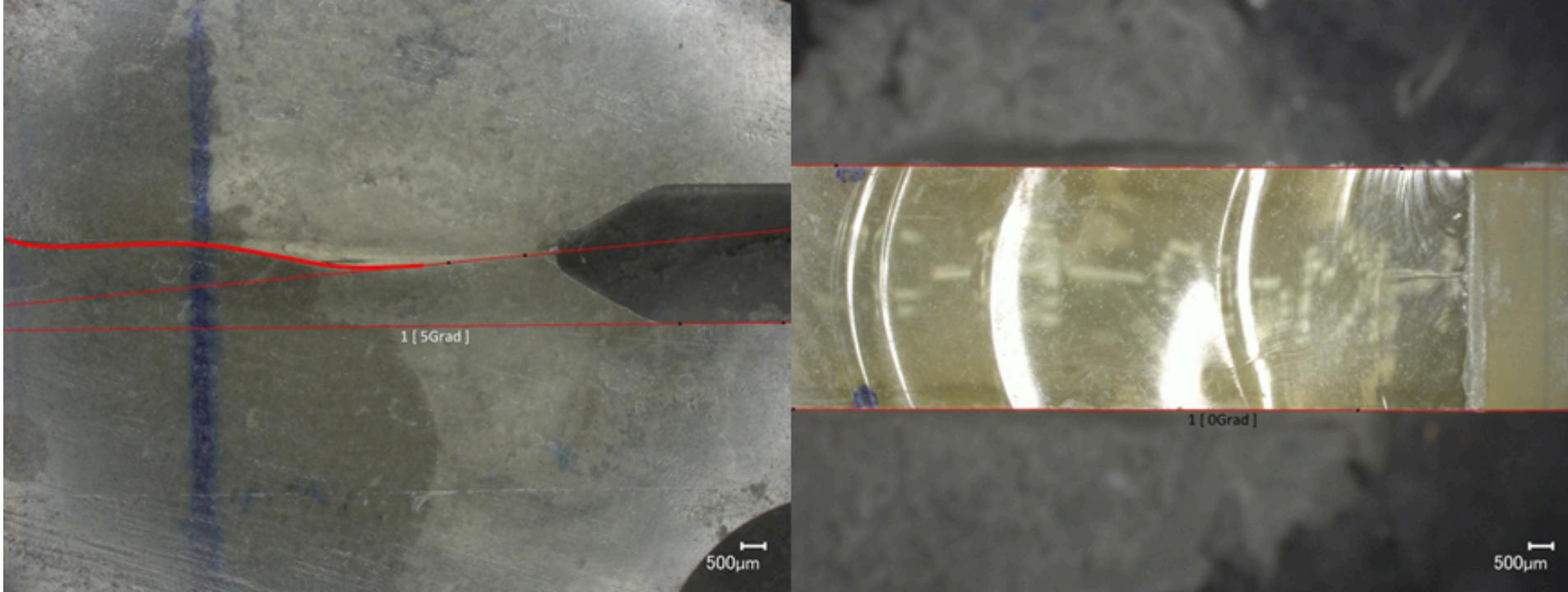
Lecture

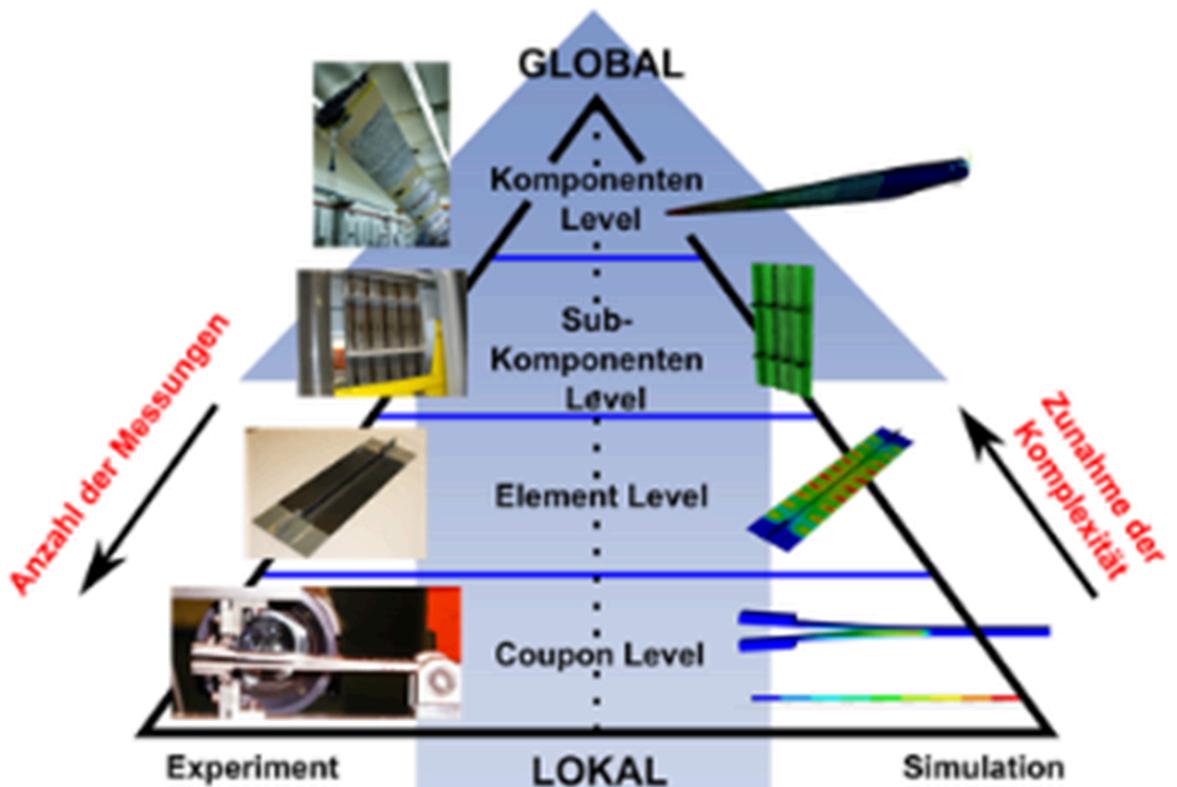
- analytical part by Prof. Dr.-Ing.
habil. Konstantin Naumenko
- Numerics and application by
Prof. Dr.-Ing. Christian Willberg









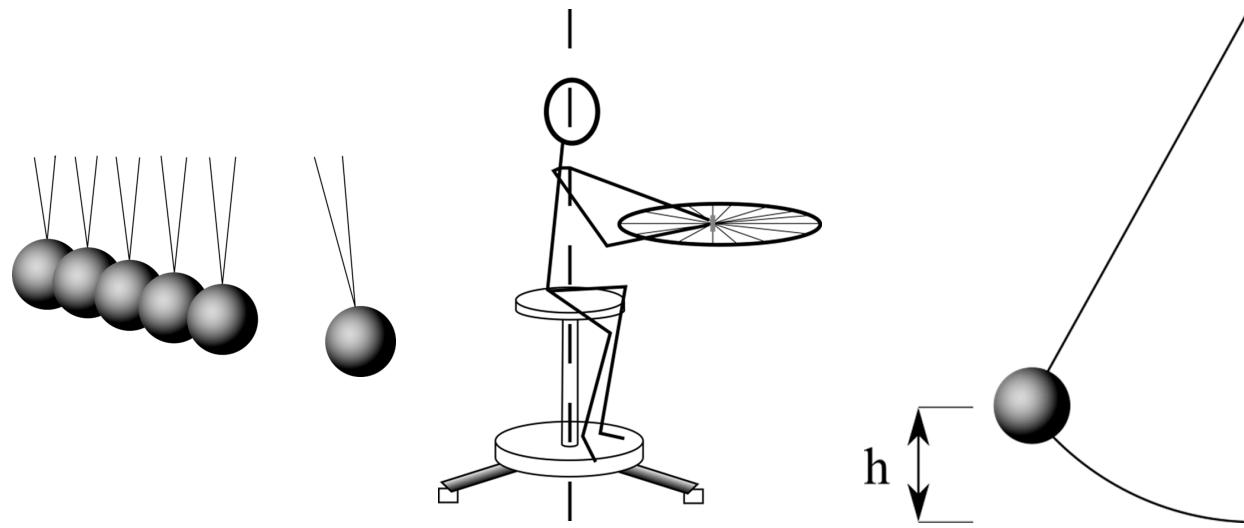


Understanding of fractures is needed for

- reducing experiments
- fatigue prediction
- crack growth and residual strength estimation

Assumptions in classical continuum mechanics

- Continuous medium
- \mathbf{u} 2x continuously differentiable
- Conservation equations satisfied (momentum, angular momentum and energy)



Conservation of Momentum

$$\operatorname{div} \boldsymbol{\sigma} + \mathbf{b} = \rho \ddot{\mathbf{u}}$$

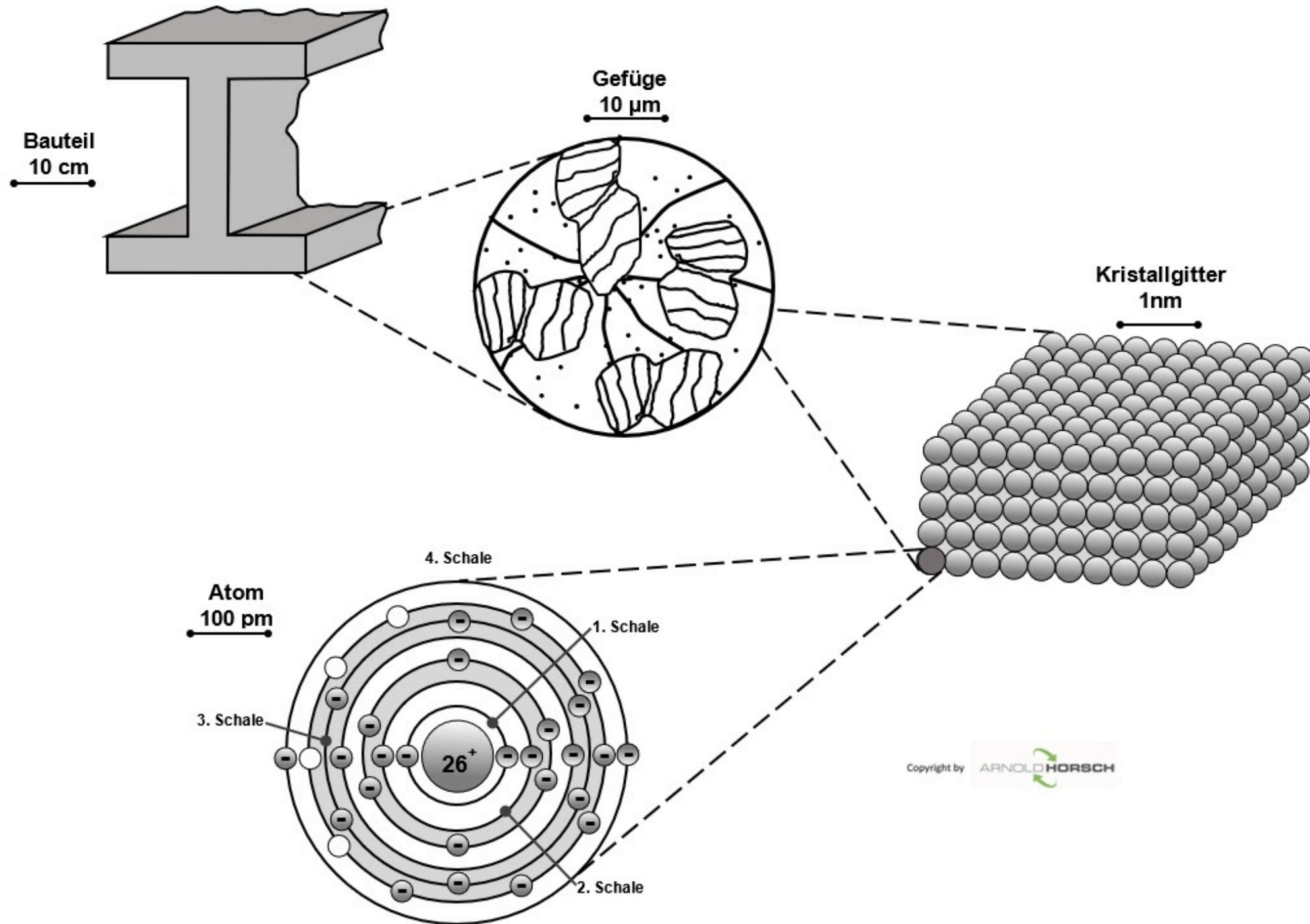
Implications 1D

truss with 2 areas

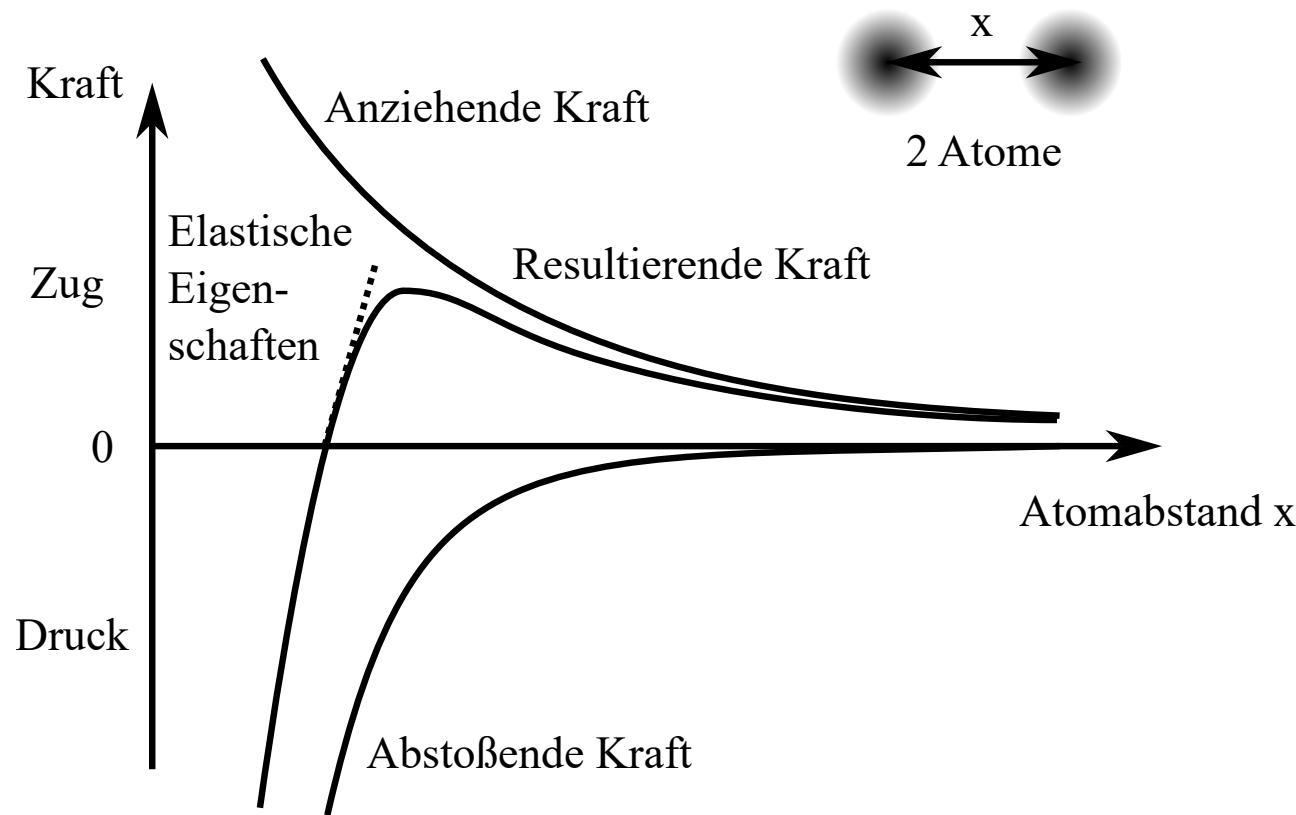
$$\sigma_1 = \frac{F}{A_1}, \sigma_2 = \frac{F}{A_2}$$

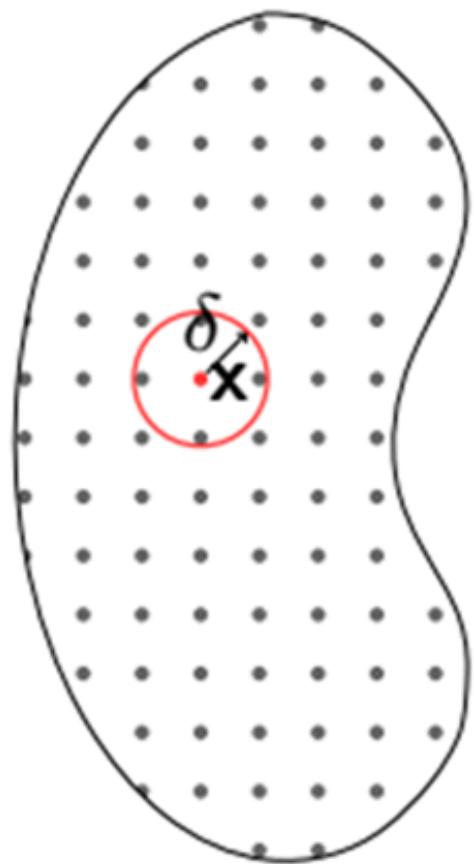
$$\operatorname{div}\sigma = \frac{d\sigma}{dx}$$

no derivative exists at the position, where A_1 becomes A_2

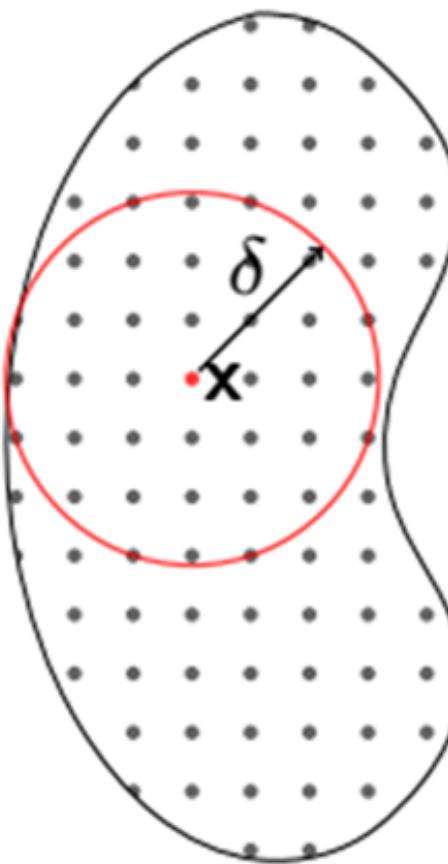


Reality is non-local

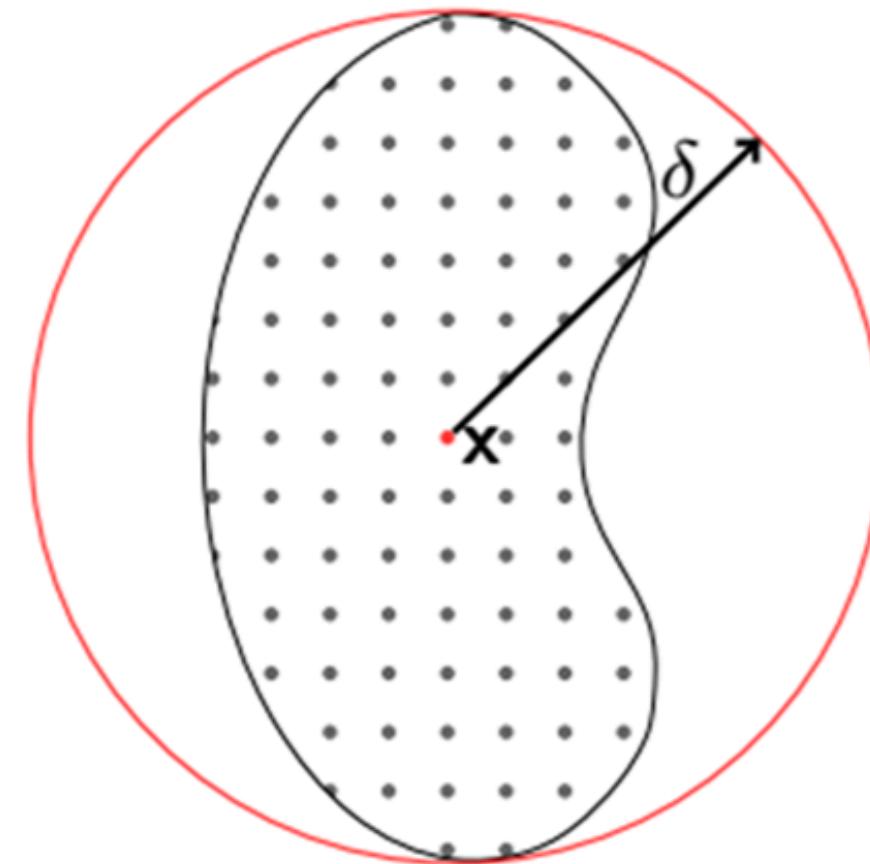




Continuum Mechanics
Local Model



Peridynamics
Non-local Model



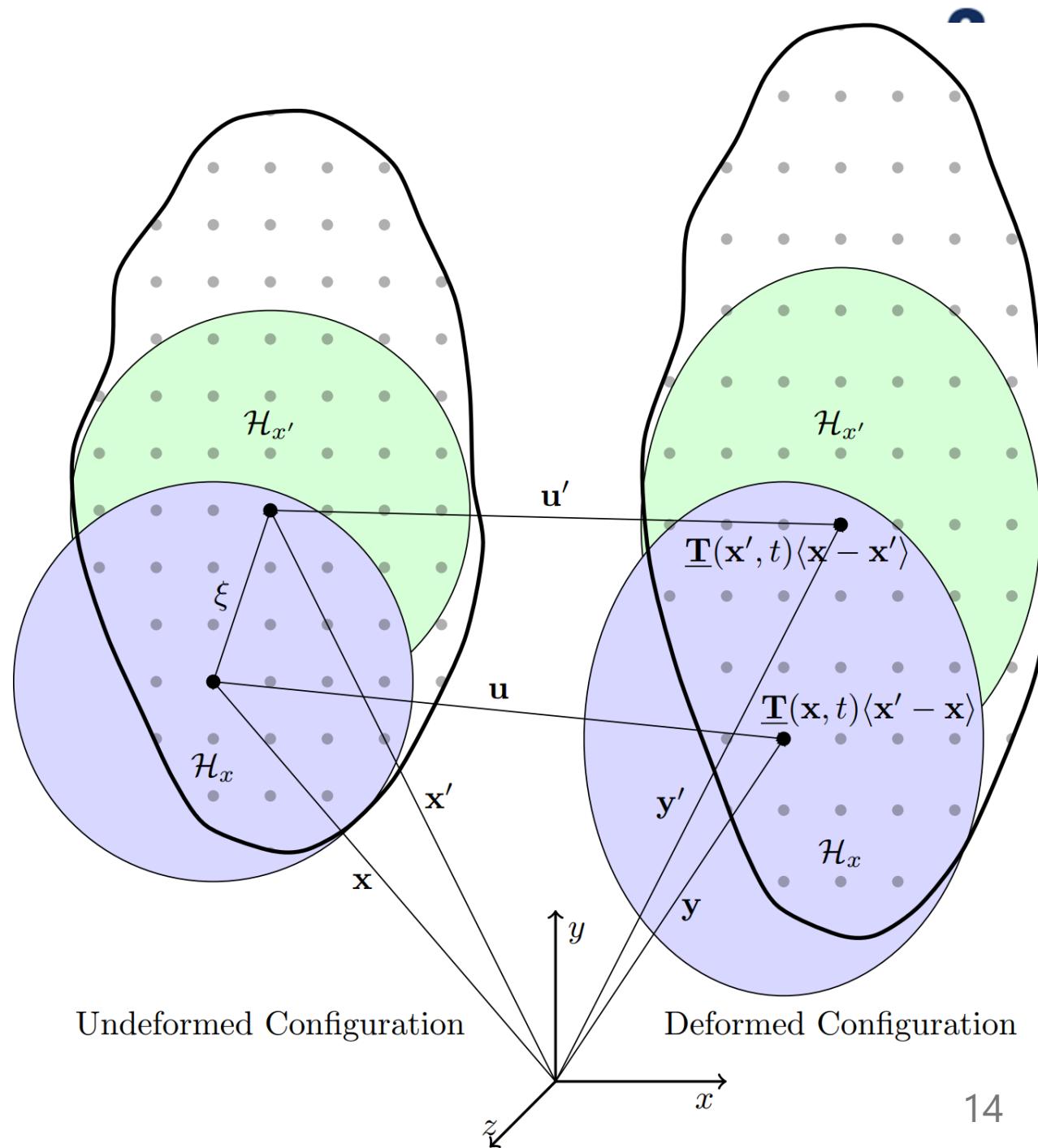
Molecular Dynamics

Peridynamics (PD)

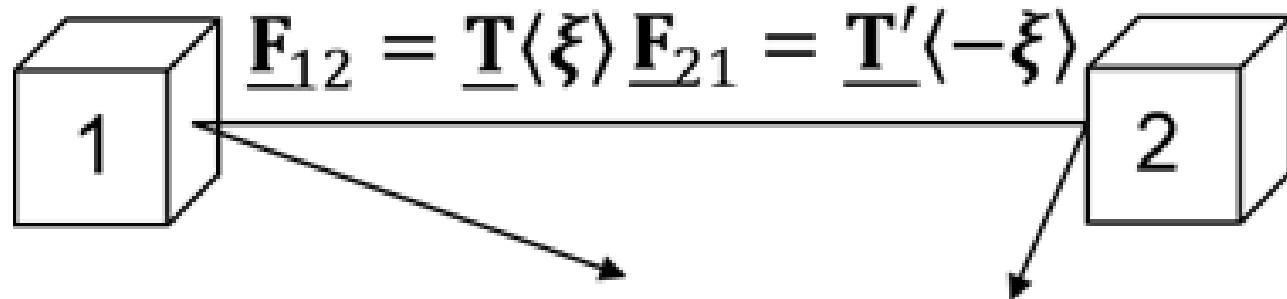
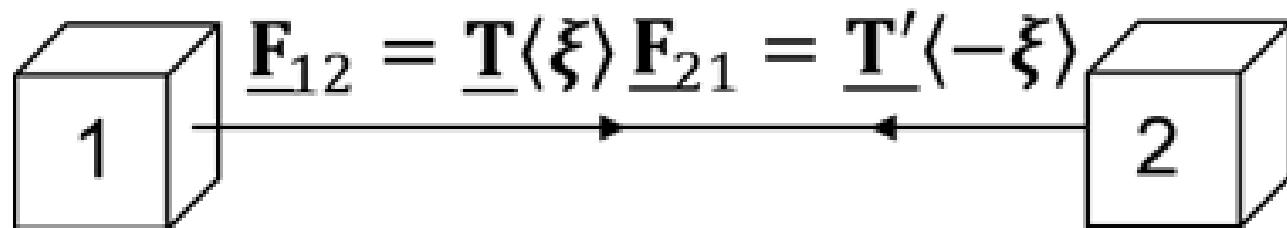
$$\int_{\mathcal{H}} (\underline{\mathbf{T}}(\mathbf{x}, t) - \underline{\mathbf{T}}(\mathbf{x}', t)) dV_{\mathbf{x}} + \mathbf{b} = \rho \ddot{\mathbf{u}}$$

- material point
- bond
- neighbor
- integral domain
- horizon
- deformed bond state
- ...

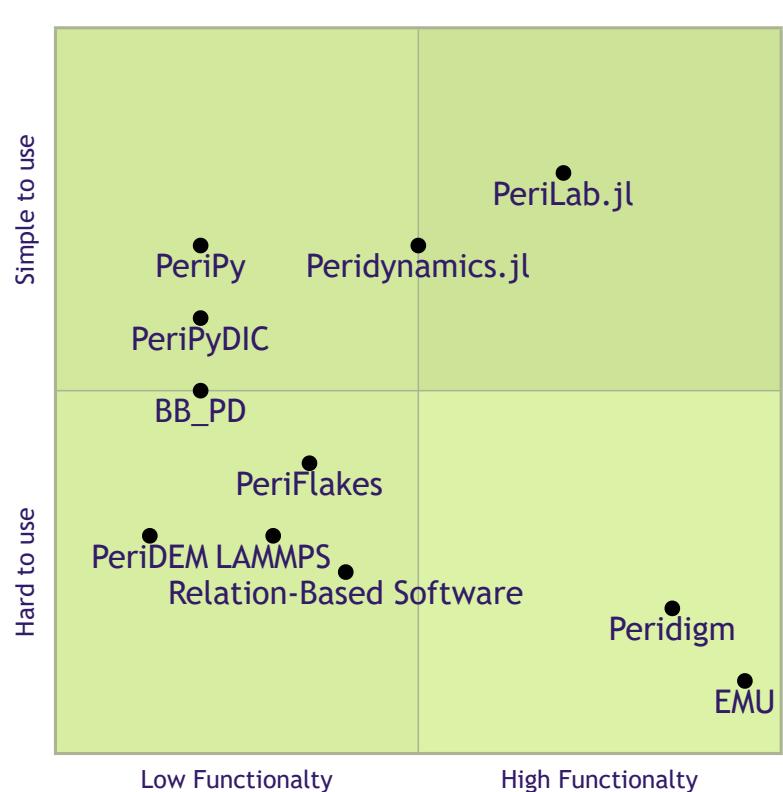
PD is a continuum formulation!



Model	Conservation of Momentum	Conservation of Angular Momentum
bond-based	bond	bond
ordinary state-based	integral	bond
non-ordinary state-based	integral	integral



Software

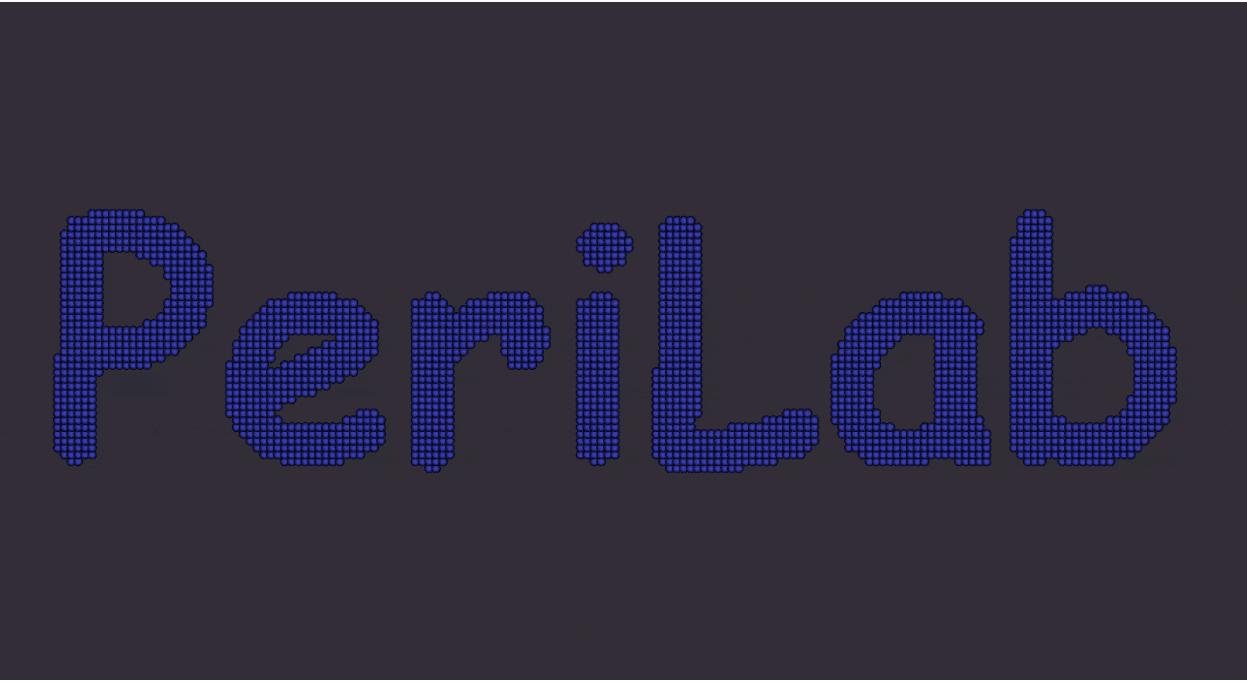


Software

PeriLab Repository

- install julia language
- start julia
- write in t

using Pkg
 Pkg.add("Peri



Application - run julia

using PeriLab

PeriLab.get_examples() (optional)

PeriLab.main("examples/DCB/DCBmodel.yaml") (run run model)

Seminar

Theory

Examples for the seminar

Results