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Master thesis/Studienarbeit

Implementation of Digital Volume Correlation

Digital Image Correlation (DVC) compares two images to calculate displacements, and subsequently the surface strains on a structure. This method is well established. In the last 15 years, however, Digital Volume Correlation, where 3D-image data is used instead, have gained significant attention (Figure 1). At the Institute of Applied Mechanics, we have a CT-scanner that we use to get microstructure information for different materials, for example concrete. We use this microstructure to simulate multiple physical processes in the material, including the mechanical response (stress-strain). An important validation of these models could come from accurate identifications of the 3d-strain fields, but currently available DVC-softwares are not producing sufficiently accurate results.

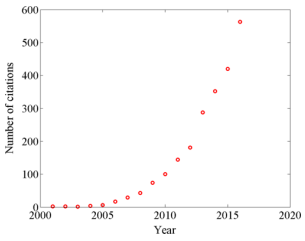

Fig. 1) Articles on "Digital Volume Correlation"[1]

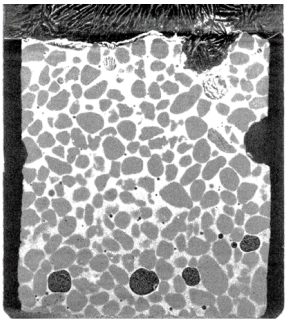

Fig. 2) CT-scan of water freezing inside concrete

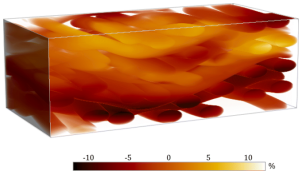

Fig. 3) DVC-calculated shear strains in a composite [1]

In this project, you will work on implementing the cutting edge DVC algorithms, building upon our in-house finite element code Ferrite.jl in the Julia Programming Language. The review paper by Buljac et al. 2018 [1] will serve as a starting point. The end goal is to identify the strains occurring when a water saturated concrete sample freezes, as shown in Figure 2.

Prerequisites: Linear Solid Mechanics, Programming experience/interest

Tasks

- Literature review of different DVC methods
- Learning to program in julia
- Implementation of DVC methods
- Evaluation of different methods

References

[1] Buljac, A., Jailin, C., Mendoza, A. et al. Digital Volume Correlation: Review of Progress and Challenges. Exp Mech 58, 661–708 (2018). https://doi.org/10.1007/s11340-018-0390-7