Contribution ID: **46** Type: **Talk**

Volumetric Optical Flow Network for Digital Volume Correlation of Synchrotron Radiation-based Micro-CT Images of Bone-Implant Interfaces

Tuesday 14 May 2024 10:30 (15 minutes)

In materials science research, digital volume correlation (DVC) analysis is commonly used to track deformations and strains to elucidate morphology-function relationships. Optical flow-based DVC is particularly popular because of its robustness to estimate the correlation as a dense deformation vector. Recently, computer vision researchers showed that network-based optical flow approaches can outperform classical iterative optical flow approaches. This finding has increased the interest to apply machine learning based optical flow methods for DVC.
In this work, we present a supervised machine learning approach for digital volume correlation. This approach extends the state-of-the-art network-based optical flow method, RAFT, from 2D images to 3D volumes such that it predicts the volumetric displacement vector from the input volume pairs. Experiments show that this volumetric network performs well in estimating different displacement fields when compared to cutting-edge iterative DVC methods for bone-implant materials based on high resolution synchrotron-radiation micro-computed tomography imaging data.

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Session Classification: Thematic Session: Image Analysis - part I

Track Classification: Image Analysis (focus on representation learning and foundation models): Thematic focus: Image Analysis