Contribution ID: **723** Type: **Poster (+) Presentation**

FLEXT –A Flexible Scripting X-ray Computed Tomography System for Multiscale and Dynamic Imaging of Porous Materials

Thursday, 3 June 2021 14:40 (1 hour)

X-ray Computed Tomography (CT) methods can be employed to study the internal structure of porous geomaterials non-destructively and with minor sample preparation. Previously, such methods have been utilized in the characterization of petroleum reservoirs, underground water resources, soil, and carbon storage in aquifers. X-ray CT has the potential to characterize porous geomaterials at multiple length scales and as a function of time –in the dynamic imaging mode. Multiscale and dynamic imaging of geomaterials in X-ray CT scanners however requires open hardware and software architectures that permit programming, scripting, and modifications.

We developed a flexible scripting software system in MATLAB to control the components of a non-commercial multiscale X-ray CT scanner for geological applications. The modified custom-built X-ray CT scanner is capable of imaging objects as large as 20 cm to smaller than 1 mm. The flexibility of the software and hardware permitted the placement of three rotation stages in the scanner to image a variety of samples. Many rock samples from chalk reservoirs of the Danish North Sea, on the 120-mm, 40-mm, and 2-mm length scales, were imaged and demonstrated the multiscale capabilities of the developed imaging system. Millimeter-sized, core plug, and whole core samples demonstrated the possibility of observation of a range of features, including fossils, fractures, pyrite agglomerates, pores and holes, deformation bands, and stylolites across different length scales.

A flexible imaging software system is necessary to accelerate the time resolution of dynamic imaging by algebraic iterative reconstruction or time-discrete Kalman filter algorithms. The software system developed in this work can acquire projection images at any order of angles, or combination of other stage positions, according to user input. In simple cases of full circular cone-beam datasets, all angular data are acquired in series and the same rotation pattern is repeated over time. Two dynamic evaporation experiments in a model glass-bead pack and a natural chalk core plug demonstrated the dynamic capabilities of the scanner. In evaporation of deionized water in a glass bead pack, water evaporated over the course of more than 3 days and left pendular rings behind. The evaporation of saltwater from a 3.9-mm-diameter Stevns Klint chalk plug demonstrated the possibility of observing efflorescence, the formation of a crystallized salt layer on the porous medium, and changes in the liquid phase content through partial volume effects.

Flexible X-ray CT systems such as the one described in this work provide opportunities to easily and quickly learn and modify existing imaging protocols and add new layers of hardware and software to explore new ideas.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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