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Cone beam computed tomography reconstruction for digital rock

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Digital rock physics (DRP) is the derivation of rock properties from scanned volumes of core plugs [1]. The scanning modalities include 2D-based techniques such as light sheet microscopy, scanning electron microscopy and confocal microscopy, which gives slice-wise information of the rock, and 3D-based techniques such as clinical x-ray tomography, cone beam computed tomography (CBCT), and magnetic resonance imaging, which results in volumetric information of the rock. CBCT imaging, widely used for pore scale studies, provides a relatively high resolution (1 to 4 micrometers) in a reasonable time frame (4-5 hours). The volume is reconstructed from tomographic projections acquired in CBCT using the "back projection"principle, well-known as the Feldkamp Davis Kress (FDK) algorithm [2]. The acquisition leads to noise in the volume due to electronic round-off errors, reduced photon-count, scattering of x-rays, extinction of rays around high-absorbing material, beam hardening as the rays pass through the sample, ring artefacts because of detector pixel malfunction and so on [3, 4]. The analytical reconstruction technique leads to artefacts such as the exponential edge gradient effect where the edges are at high intensity due to the assumption of finite focal spot of the source and aliasing error due to violation of Nyquist sampling. The drift of the sample from the imaging plane, further degrades the image. The quality of the volumes can be improved multifold by fine-tuning the reconstruction algorithms to suit the digital rock domain. Unfortunately, commercial scanners don't provide access to the algorithm for studying the impact of these parameters on the rock samples. To circumvent these issues, we have modified the FDK code available in open access. The code has been incorporated with correction of the angle drift in the sample, which is recorded by the goniometer in the scanner. Positioning of the sample out-of-line of acquisition is inevitable due to its shape and size [5]. The code was also modified to take the center-shift into consideration while executing the reconstruction. This leads to the requirement of a tool to automate the calculation of center-shift, eliminating human decision as to the best value, and is the subject of our future work. The FDK code run time was reduced from 10 minutes to a few seconds by parallelizing the code on GPU and changing the programming language to C. This high-speed code was used to reconstruct the volumes at resolutions higher than the acquired resolution, which is enabled only by this scanner independent FDK algorithm.

- Corresponding author - Dr Jaya Prakash, Department of Instrumentation and Applied Physics, Indian Institute of Science, Bengaluru, Karnataka, India.

Time Block Preference

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

References

[1] H. Andrä et al., "Digital rock physics benchmarks—Part I: Imaging and segmentation," Computers & Geosciences, vol. 50, pp. 25-32, 2013, doi: 10.1016/j.cageo.2012.09.005.

[2] L. A. Feldkamp, L. C. Davis, and J. W. Kress, "Practical cone-beam algorithm," JOSA A, vol. 1, no. 6, pp. 612-619, 1984.

[3] R. Schulze et al., "Artefacts in CBCT: a review," (in eng), Dentomaxillofac Radiol, vol. 40, no. 5, pp. 265-273, 2011, doi: 10.1259/dmfr/30642039.

[4] A. K. Nagarajappa, N. Dwivedi, and R. Tiwari, “Artifacts: The downturn of CBCT image,” (in eng), J Int Soc Prev Community Dent, vol. 5, no. 6, pp. 440-445, Nov-Dec 2015, doi: 10.4103/2231-0762.170523.

[5] S. Valton, F. Peyrin, and D. Sappey-Marinier, “A FDK-based reconstruction method for off-centered circular trajectory cone beam tomography,” IEEE transactions on nuclear science, vol. 53, no. 5, pp. 2736-2745, 2006.

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Primary authors: Ms PERIYASAMY, Vijitha (Researcher); Dr METRI, Vishal (Researcher); Mr SINGH, Avanindra (Researcher); HOFFMAN, Ronny (Senior Petrophysicist); Dr TANDON, Kunj (Manager); YALAVARTHY , Phaneendra K (Professor); PRAKASH , Jaya (Assistant Professor)

Presenter: Ms PERIYASAMY, Vijitha (Researcher)

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