

4D imaging of sub-second dynamics in pore-scale processes using real time synchrotron x-ray tomography Review

This is a really impressive piece of work, and I congratulate the authors - this, coupled with the highlighted optimisation to allow even faster acquisition times, will allow a step-change in time-resolved CT studies. Nice work. I have a couple of questions, the authors may choose to include discussion of if they believe it is pertinent:

-- The grain size of the sandstone gravels isn't highlighted; I assume they were coarse from the figures. What will be the challenges in extending this kind of study to non-disaggregated sandstones, especially those of smaller grain size? I assume rate of data acquisition will take a hit with higher resolution and concomitantly smaller field of view.

-- Does the rate of rotation affect the behaviour of the fluid in any way?

I include a number of smaller corrections/suggestions below. I'm happy to be identified as a reviewer.

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-- "The method presented here are capable" → "The methods presented here are capable"

-- "in both micro and macro-scale flow" → "in both micro- and macro-scale flow"

-- "quantitative imaging of the complex natural pore networks" → "quantitative imaging of complex natural pore networks"

-- "Wildenschild and Sheppard, 2013) The data are" → "Wildenschild and Sheppard, 2013). The data are" - also, is inform the right choice of words here. They are often being used as a basis of, not just an influence on. Inform implies the latter to me.

-- "constant angular density" - the word density here is not ideal, as it's a relatively unusual usage and a person skim reading may mistake it for physical density and be confused. I suggest rewording.

-- "In this mode, samples rotation" → "In this mode, sample rotation"

-- "Pushing time integrated tomography towards true long duration 4D imaging would therefore have high impact on our understanding of pore scale processes." I agree

-- "up to an odder of" → "up to an order of"

-- "Perspex sample chambers of 6 and 25 mm internal diameter cells used here." - I think you're missing a word or two here. Were used?

-- "above the outlet feed prevented fine material" → "above the outlet feed to prevent fine material"

-- Figure 2 - these are really nice slices, and C v.s. D is compelling. Is it possible to add slices images for E v.s. F for clarity?

-- "The maximum rotation speed of the JEEP tomography stage is 10 Hz (continuous rotation)" and is there any limit to how long it can rotate for?

-- "In white beam mode" - which I assume you used for higher flux, right? Could it be worth stating this? Do you have any beam hardening or other artefacts as a result? Would switching to mono for better contrast reduce the maximum rate of data acquisition?

-- "Using the routine filter back projection reconstruction algorithms" → "Using the routine filtered back projection reconstruction algorithms"

- "two under-sampled data sets shows" → "two under-sampled datasets shows"
- "of projections is dependant" → "of projections is dependent"
- Figure 5 - I suggest for clarity you label which colour (red/blue) represents inter/intra grain volume fraction respectively
- "Well established network analysis" → "Well-established network analysis"
- Figure 8 - F50; there's a typo in isolation
- 4.2 Case Study: In situ observation of mixing dynamics - throughout this section you refer to figure 9 - I think you mean figure 8.
- "The iterative data have fewer line artefacts and lower noise, and permits accurate phase segmentation from fewer than 45 projections." but is, I assume, quite computationally expensive. If so, can you flag this? How much longer does each frame take to reconstruct? Is iterative reconstruction for all frames in a 4D study realistic?
- "The development of ultra-high speed imaging mean" → "The development of ultra-high speed imaging means"