

Connecting the time dimension

Dynamic μ CT reconstruction using piecewise linear fitting

M. Heyndrickx¹, M.N. Boone¹, T. Bultreys², L. Van Hoorebeke¹

¹ UGCT / Radiation Physics, Dept. Physics and Astronomy, Ghent University, Belgium

² UGCT / PProgResS, Dept. Geology and Soil Science, Ghent University, Belgium

The problems of dynamic μ CT

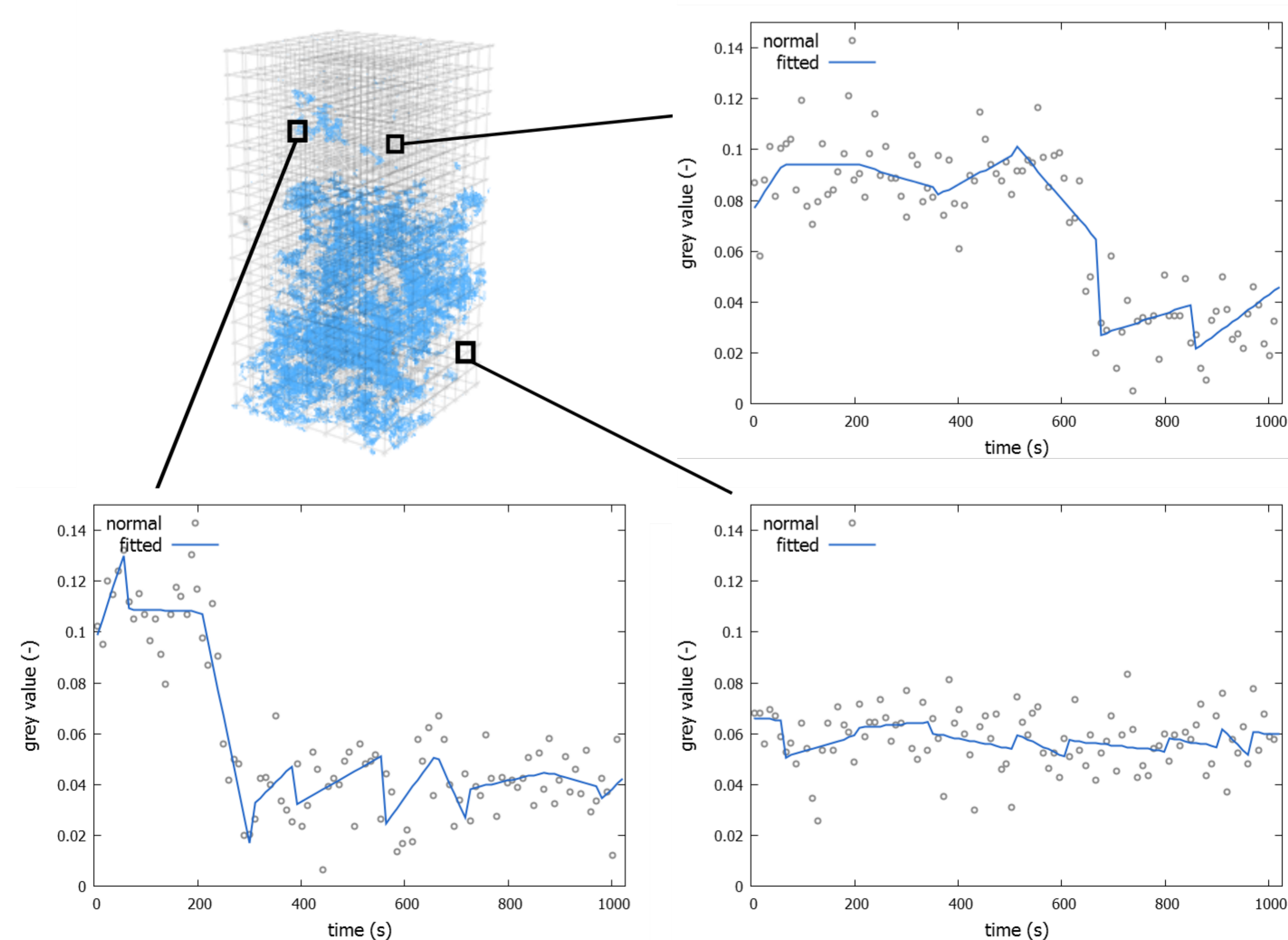
Dynamic μ CT or 4D μ CT is the CT scanning of samples that undergo a dynamic process during the scan. An example is fluid flow through rock. This typically involves very fast imaging to analyse fast processes. The acquisition covers multiple rotations. The main problems in reconstructing dynamic μ CT scans are:

- High noise
- Movement artefacts

Can piecewise linear fitting solve these?

How does this work?

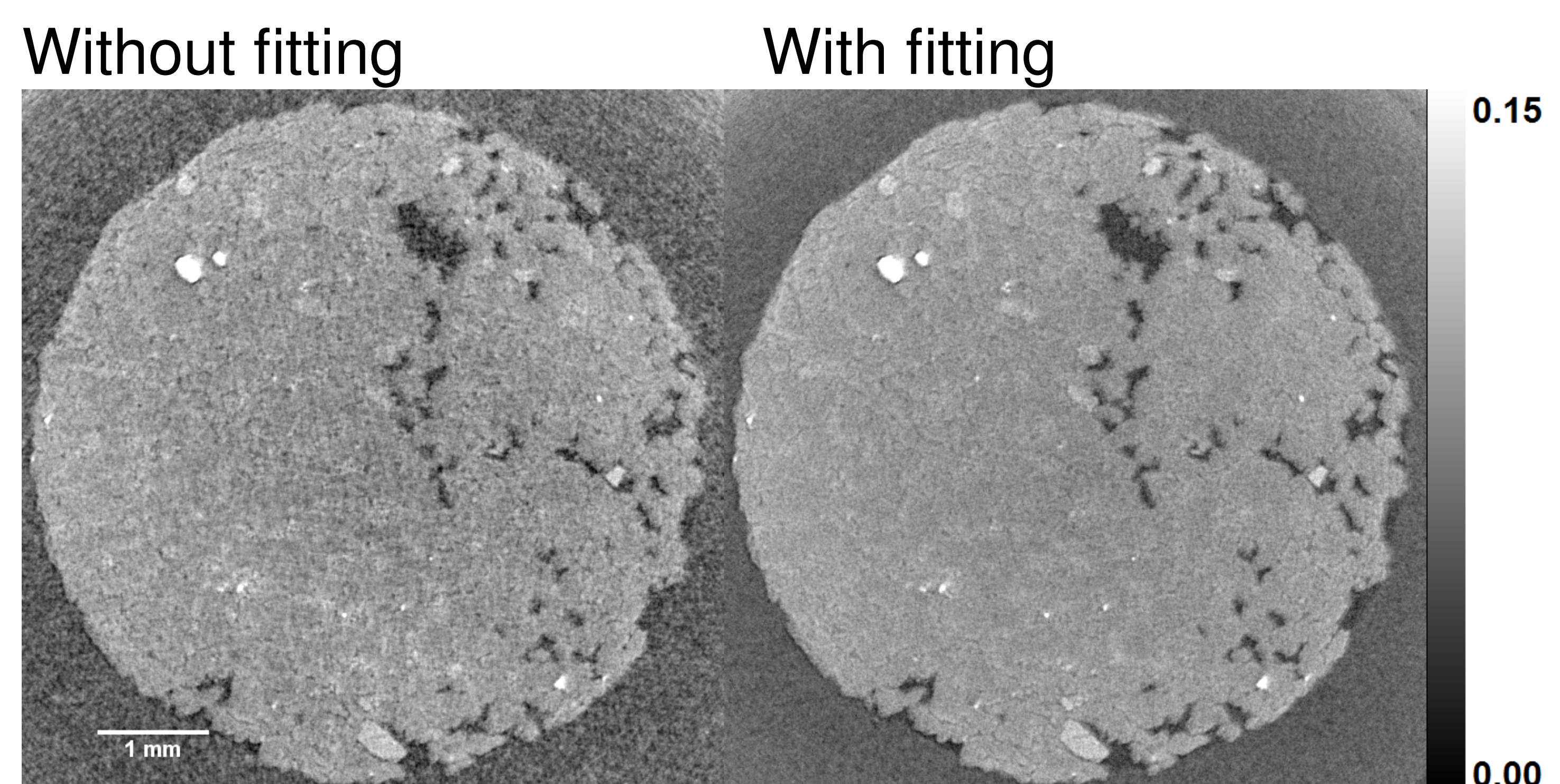
1. Scan the sample
2. Divide the scan into "time steps". Perform a 3D reconstruction for each time step.
3. Plot the grey value of one voxel in function of time
4. Fit a piecewise linear function to this plot
5. Repeat for every voxel



Contact

Marjolein.Heyndrickx@UGent.be

Results



This is a slice of the 4D volume representing one time moment of fluid (black) flow through porous rock (light grey), both without (left) and with (right) piecewise linear fitting.

Advantages and disadvantages

- + Significant noise reduction
- + Sudden changes are captured (breakpoints)
- + Improves temporal resolution
- + Very general (almost any sample)
- + Any 3D reconstruction method can be used
- No small peaks in time evolution ($\approx$ noise)
- Can cross logical boundaries (i.e. $\mu < 0$)

Conclusion

Piecewise linear fitting can improve the result of a dynamic μ CT scan. The main advantage is the noise reduction. Even though it operates in the temporal dimension, noise in the spatial dimensions is also reduced.

Acknowledgments

Research funded by a PhD grant of the Research Foundation Flanders (FWO).

The Special Research Fund of the Ghent University (BOF) is acknowledged for the post-doctoral grant to M.N. Boone.