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Interactive comment on "Recent developments in neutron imaging with applications for porous media research" *by* A. Kaestner et al.

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Received and published: 6 May 2016

Dear Mr Fusseis

First we would like to thank you for your effort with our manuscript. In this response we omit the language related comments (from which most were adopted or turned obsolete during the revision) and focus on the unclear details which we have addressed during the revision of our manuscript.

Best regards

Anders Kaestner

Page 1: 1. Bi-modality is two experiment method (modalities) are used to investigate

the sample. The purpose is to decrease ambiguities that could appear when only a single modality is used. 2. In our revised manuscript we have added new references to applications of neutron imaging as well as more general information about the method and the neutron-matter interaction mechanism.

Page 2: The comments on page 2 where mainly language related. Most were adopted, while sometimes we preferred a reformulation.

Page 3: The comments on page 3 where mainly language related. Most were adopted, while sometimes we preferred a reformulation.

Page 4 1. The composition of the sample certainly plays a role in the detectability. We took this for granted and were focusing on the low contrast case where the noise level plays an important role in for the detectability. The revised manuscript will clarify this.

Page 5: Section 2.1 has been completely rewritten in the revised manuscript. 1. The tilted detector has thanks to the arrangement with a mirror has the ability to increase the resolution in one direction. This results in anisotropic pixels. Revised manuscript will clarify this. 2. The word "apparently" has been upgraded to a clear statement that it is possible to achieve resolution below 10 microns using pixel detectors. Added reference to Poster abstract.

Page 6: 1. The upper limit is how much beamtime you are assigned… On the lower end it depends on how many projections you would need and the exposure time. As a guideline I'd say from 18h you can start talking about useful quality for full frame projections, longer exposure time will be beneficial to improve the SNR. Often we don't use full-frame acquisition since sample dimensions are smaller than the width of the FOV this will reduce the number of projections and thereby also the acquisition time.

Page 7: Section 2.2. has been rewritten to read better 1. It is a requirement from the user community to be able to observe the behavior of processes and it is an instrument capability being able to do so. 2. The first sentence has been rewritten to point out

the difference between systems at steady state and ongoing processes. Section 2.2.1 1. Changed the word statistics to dose (neutron flux x exposure time) and revised. 2. Probability of detection is signal processing talk and is related to the probability to detect (segment) correctly. Changed to "segmentation performance".

Page 8: 1. Revised the sentence about tuning the time scale. It is not during reconstruction, the choice is made before you start the reconstruction but clearly after the experiment. 2. We define rapid process as: Too fast for the comfort zone with small pixels and high contrast... Changed rapid to: fast relative to the acquisition rate.

Page 9: The section has been rephrased to correct the unclear formulations. The new version more focus on the imaging experiment than on root-water processes. 1. Clarified that data here refers to time series of neutron radiographs. 2. The temporal resolution is about 2-6 CTs per minute which is pretty high for the neutron flux at ICON.

Page 10: 1. The previous experiment demonstrated that on-the-fly CT is possible using neutrons. Here, we increase the frame rate by a factor 6 at maintained pixel size. 2. Lines have been to indicate the location of the slices are added in figure 4. 3. We have been using volumes a bit simplified. We refer to CT volume data sets. Revised to clarify this.

Page 11: 1. The sentence about spatial and temporal resolution rephrased to explain what we mean by sufficient resolution by emphasizing on the sampling rate to obtain artifact free CT volumes representing the observed process. 2. The phrase about new avenues is obsolete in the revised version. Section 2.3 1. We have clarified in the revised version that the inaccuracies are related non-equidistant angular sampling along the acquisition trajectory and low intensity dynamics.

2. The considered reconstruction techniques are based on the SIRT and CGLS reconstruction techniques with different regularization criteria.

3. The mentioned streak artefacts with increasing strength when the number of pro-

jections falls far below the number suggested by the sampling theorem. The streaks are mainly tangential to the sample and increase in strength the further away from the reconstruction center they are. The revised manuscript will make this clearer and relate the number of used projection to the number recommended by the sampling theorem.

Page 12: 1. We prefer to use the term use-cases instead of applications since it is a more general separation between ways to use a method. 2. There are different levels of fusion, case 1 and 2 are simplified cases that may be sufficient but it can come to the case that the combination is required.

Page 13: 1. SLS is not necessarily involved, but it could and has also been done in previous experiments. The problem with experiments using both facilities is the sample activation and that our radiation protection staff is not available day and night to clear the samples for transfer. Added a sentence about this and the waiting times required for sample deactivation. Our aim is to provide in-situ installations that reduce the waiting times and the one at ICON could in principle also allow near simultaneous bimodal acquisition (still under development and testing).

Page 14: 1. Rephrased to clarify that we mean preferential water flow. 2. The highly conductive regions in this particular soil are macro pores, fractures and high porosity regions.

Page 15: 1. Reformulated to clarify that there was a reduction in water content that could be quantified. 2. The conclusion section has been fully revised; most of the remaining comments on page 15 are thereby taken care of. 3. When we talk about volumes we refer to reconstructed CT volumes. The revised version will clarify this.