MuhRec – a reconstruction tool for neutron and x-ray tomography

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The aim of this contribution is to present the MuhRec software, which is a framework for computed tomography reconstruction based on filtered back projection. MuhRec is a multi platform non-commercial software for computed tomography (CT) reconstruction that has been developed at the Paul Scherrer Institut to support research and users at the neutron imaging beamlines [1]. Its development is ongoing and it was chosen in the framework of the European project SINE2020 (www.sine2020.eu, [Accessed 27 April 2017]), to provide to the neutron imaging community a general tool for tomographic image reconstruction. In this framework, open source release of the software is also foreseen during 2017.
The software is able to load raw projection data and reference images of different format (e.g. series of fits, tiff and NeXus file). From these, the reconstruction engine is designed to allow for a flexible configuration of an arbitrary set of pre-processing modules followed by one back projection module. For neutron imaging experiments, the most common configuration includes: i) computation of attenuation images from raw data with normalization to reference images, ii) spot cleaning iii) ring cleaning, iv) projection filter and v) back projection for parallel beam geometry.
Its modular structure enables the extension with new reconstruction algorithms or pre-processing modules. Among these, implementations of the wavelet-based ring cleaning filter [2] and the adaptive filter [3] have been added.
Recent efforts were also focused on supporting cone-beam geometry. This is due to the fact that the neutron beam is slightly divergent resulting in non negligible cone beam effect in some experiments. Furthermore, there is an increasing number of second modality installation using X-rays on neutron imaging beamlines world-wide. The cone beam reconstructor is thus required to reconstruct the data from both modalities.
The CBCT reconstruction option uses the Feldkamp-Davis-Kress (FDK) algorithm [4] that was derived from the open source library plastimatch (www.plastimatch.org, [Accessed 27 April 2017]) implementation and adapted to work within the MuhRec environment. The GUI was accordingly modified to include the CBCT parameters that describe the geometrical relationship between the source, the detector and the sample: source to object distance (SOD), source to detector distance (SDD) and the piercing point, i.e. the point on the detector closest to the source. Methods for automatic computation of projection matrices for circular orbit and to estimate the piercing point position within the image position by processing open beam images were implemented.
Both command line and GUI modes are available, to facilitate users to set up the reconstructor and execute the processing.
Examples of reconstruction with typical pre-processing pipeline will be shown for both neutron and x-ray tomography.

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