Single grating X-ray phase-contrast tomography for evaluation of brain tissue degeneration on cellular level

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**INTRODUCTION:** Three-dimensional (3D) characterization of brain tissues on cellular level is attractive for neurodegenerative studies as it can improve understanding of such diseases that cause a progressive deterioration as Alzheimer's or Parkinson's diseases. Grating-based X-ray phase-contrast microtomography (PCµCT) is a non-destructive 3D imaging modality that allows simultaneous reconstruction of absorption, phase and scattering (dark-field) data [1], which is suitable for visualization of soft and hard tissues [2] with cellular resolution, and which can be implemented into a laboratory environment. The aim of the present study is to evaluate performance of the single-grating interferometry for a brain tissue investigation, using a human cerebellum block as an example.

**METHODS:** A human cerebellum extracted from a 73 year-old male was visualized post mortem. The tissue was formalin-fixed, dehydrated and paraffin-embedded. Cylindrical specimens were 4 mm in diameter and 23 mm in height. The imaging data was acquired using a single-grating setup at Diamond Manchester imaging beamline I13-2 (Diamond Light Source, Didcot, UK). The tomography was performed over 180º with a step of 0.15º, at a mean photon energy of 19 keV, using Ni grating with a periodicity of 10 µm and structure height of 10 µm, effective pixel size of 2.3 µm, at a grating-detector distance of 72 cm, corresponding to a 1\textsuperscript{st} Talbot order.

**RESULTS:** As demonstrated in the selected slice in Fig. 1, PCµCT data reveals a variety of tissue types including stratum granulosum (1), stratum moleculare (2) and white matter (3), individual blood vessels and a diversity of cell types. These presumably include Purkinje cells (white arrow), granule cells in the stratum granulosum, and stellate cells in the stratum moleculare. The phase images reveal inner structures of the tissue with high contrast while the absorption data provides a complementary edge enhancement.

**DISCUSSION & CONCLUSIONS:** PCµCT is well suited for 3D characterization of physically soft tissues as it provides a superb price-performance ratio between spatial resolution, density contrast, and required time. PCµCT bears the potential to become an important auxiliary modality in neurodegenerative disorders research.

**REFERENCES:**

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