A sample and data management system for μCT-based X-ray histology

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While setting up a facility for X-ray histology (XRH) [1] in Southampton the challenge arose of how to manage samples, data and associated metadata. This is challenging as the same sample can be analysed multiple times in different states and different modalities including micro-computed tomography (μCT), conventional (2D) thin section-based histology/whole-slide imaging or immunohistochemistry. A fresh piece of tissue may be imaged, frozen, imaged, embedded in paraffin wax, imaged, and sectioned and processed using histological techniques, all of which needs to be included attached in the sample record. Moreover, sample and data management system needed to be user-friendly. These requirements have led to the development of XRHMS, a management system to keep track of all samples within the facility, their data and their metadata, as summarised in Figure 1. Metadata of interest about the sample includes details about the tissue type and origin, preparation, storage requirements and current location.
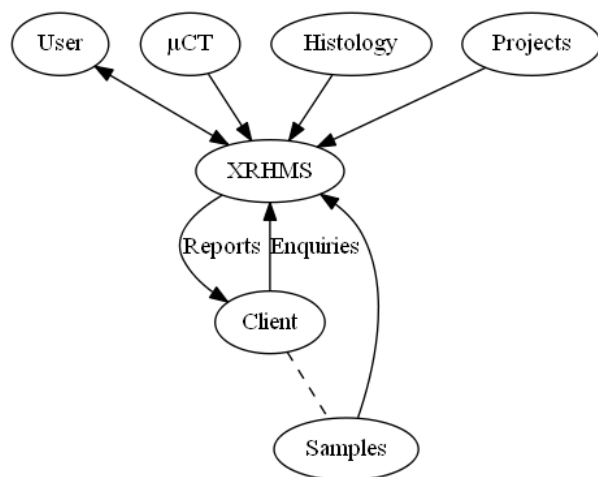

Figure 1 Information included in XRHMS

The combination of storing raw / processed image data and metadata requires careful architectural decisions, and is built on previous work in this area [2] and uses a database for the metadata and file system for the μCT data. The system can store data from multiple different acquisition systems and digitised histological slides, and is designed to be easily extensible. The XRHMS provides full tracking and accounting of all samples/data/processes and enables cross-linking between related datasets.

The XRHMS also forms the basis for automation of data processing, with preview images and slices generated automatically, as well as performing basic pre-processing, with additional features

planned. The system can generate summary reports about the samples containing information about the scans performed and related images. These provide a useful overview of the scan and data interpretation guidance for people not familiar with the technique or viewing 3D datasets.

1.   Katsamenis, O.L., et al., *X-ray Micro-Computed Tomography for Nondestructive Three-Dimensional (3D) X-ray Histology.* American Journal of Pathology, 2019. **189**(8): p. 1608-1620.
2.   Wollatz, L., et al., *Curation of image data for medical research.* Proceedings - IEEE 14th International Conference on eScience, e-Science 2018, 2018: p. 105-113.