Biomedical Image Analysis and Processing in Clouds

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Abstract. Cloud-based Image Analysis and Processing Toolbox project runs on the Australian National eResearch Collaboration Tools and Resources (NeCTAR) cloud infrastructure and allows access to biomedical image processing and analysis services to researchers via remotely accessible user interfaces. By providing user-friendly access to cloud computing resources and new workflow-based interfaces, our solution enables researchers to carry out various challenging image analysis and reconstruction tasks. Several case studies will be presented during the conference.

Keywords: Image analysis, image processing, image reconstruction, cloud computing.

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OVERVIEW

Recently, biomedical imaging has provided significant progress in providing image contrasts and resolution never achieved before. Magnetic Resonance Imaging (MRI), Computerised Tomography (CT), Positron Emission Tomography (PET) and microscopy are fundamental tools used in biomedical research. To analyse data quickly and reliably medical researchers need new facilities for image analysis, processing and reconstruction. Thanks to the National eResearch Collaboration Tools and Resources (NeCTAR) [1, 2] project, and CSIRO's Computational Simulation Sciences TCP, we are now able to provide improved access to the existing biomedical image processing and analysis software packages to research communities via remotely accessible user-interfaces, from anywhere in the world through a web browser. The toolbox provides an easy method to analyse large data sets of 2D and 3D images from experiments or clinical studies. It also allows creation of reusable and shareable workflows that define complex image processing algorithms (Figure 2). The use of cloud-based image analysis tools will increase productivity when conducting complex image processing and analysis with large datasets and hopefully will accelerate scientific discoveries.

Currently, the software toolbox includes:
• HCA-Vision [3]: developed for automating the process of quantifying cell features in microscopy images. The modules range from specific algorithms for detecting objects typically found in microscopy images such as cells, neurons and neurites to generic detection capabilities for lines and dots.

• MILXView [4]: a 3D medical imaging analysis and visualisation platform increasingly popular with researchers and medical specialists working with MRI, PET and other types of medical images. A suite of functions has been developed for processing 2D and 3D medical data. Several advanced processing pipelines also exist, such as a cortical thickness estimation, which is used to quantify the thickness of grey matter in the brain (see Figure 1).

![FIGURE 1. MILXView (a) Brain tumor - PET scan and MRI overlaid; (b) CT scan of a prostate of a patient overlaid with radiation dose; (c) Generated 3D view of a brain allowing study of atrophy pattern characteristics of diseases such as Alzheimer's disease.](image)

• X-TRACT [5]: developed for advanced X-ray image analysis and Computed Tomography and currently in use on the MASSIVE cluster at the Australian Synchrotron, Australian National University and at Shanghai’s Synchrotron Radiation Facility in China. X-TRACT implements a large number of conventional and advanced algorithms for 2D and 3D X-ray image reconstruction and simulation.

For more information please contact authors [6].

![FIGURE 2. Processing example – Cellular Imaging.](image)
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