Adding Affine & Non-Linear 3D Reconstruction and IIP3D Visualization to OMERO 5

J. Rao, N. Burton, B. Hill and R. A Baldock

MRC Human Genetics Unit, MRC IGMM, University of Edinburgh, Crewe Road, Edinburgh EH4 2XU, UK. http://www.emouseatlas.org/

Introduction:

Here we demonstrate a use-case from the work of the eMouseAtlas [2] group in Edinburgh which extends the capabilities of the new Open Microscopy Environment (OME) OMERO 5 image archive [1]. This has been implemented as a script which can be used to build 3D volumes from 2-D serial sections by rigid-body, full affine, or non-linear registration. We also demonstrate the integration of a 3D image viewer using IIP3D [6], which enables an OMERO authenticated user to view and navigate through sections of arbitrary orientation in a 3D volume using a web based viewer. These extensions have been made possible by the integration of the image-processing system Woolz [3] into bioformats and OMERO.



INSTITUTE OF GENETICS

& MOLECULAR MEDICINE

Non-linear registration:

High contrast 3D images are essential to understanding the structure &

Integration of IIP3D viewer with OMERO 5

anatomy as well as the function of biological systems. 3D images are often captured directly – CFLSM, microMR, microCT, OPT, HREM etc. but are also constructed by microtome sectioning then staining to enhance the required information such for example cellular morphology; the stained tissues are scanned as 2D digital images then registered and reconstructed back to a 3D volume. Bellow is an example of how a volume can be built from sections.



OMERO has a scripting engine which provides an excellent glue mechanism for integrating other systems. The diagram below shows the relationship between IIP3D and OMERO. User can use a web browser talk to a web server, in this particular instance the Apache web server is used as a proxy, which passes any request to OMERO web server which coordinates the communication between the IIP3D server, the OMERO archive and the user. In this example the 3D image is a mouse embryo [2]. The figure below, shows the work-flow of how each part of the system working together to achieve the user's view of the 3D data.





Diagram of integration of IIP3D and OMERO 5

System in use

Integration of non-linear recon with OMERO 5



TS23, 1 represent 50 sections

IIP3D Viewer:

Once captured and reconstructed 3D images can be re-sectioned with a *virtual* microtome at any orientation through the volume. The IIP3D Viewer [6] allows remote viewing of arbitrary sections through a 3D volume via a web browser, even for images too large to fit into the server RAM and without the need to download the entire volume to the client. The figure below shows the IIP3D Viewer action flow. The IIP3D server can handle, grey-value (byte, int, float etc) as well as



Using the OMERO script, after importing sections into OMERO users can select 2D sections and then reconstruct these as a registered 3D volume. The registration has been implemented using a combination of Woolz[3], VTK[5] and ITK[4]. The following figures shown the interface and results within OMERO.



Future

The system will be packaged together with full developer and user documentation for other OMERO system administrators to install.

Acknowledgment: All test data was from EMAP[2]. The work was funded by Wellcome Trust as part of the OME satellite project.

References:

[1] OMERO: www.openmicroscopy.org/site [2] eMouseAtlas: www.emouseatlas.org [3] Woolz: github.com/ma-tech/Woolz [4] ITK: www.itk.org [5] VTK : www.vtk.org [6] BMC Bioinformatics 2012, 13:122, Zsolt et al. :http://aberlour.hgu.mrc.ac.uk/eAtlasViewer_demo/application/TPRDemo/wlz/colon.php



