# Bringing the Grid to the Biomedical Workbench

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## *Abstract*

*Modern biological research is data intensive and relies on an efficient informatics infrastructure. Research on the genetic control of embryo development involves large volume image data requiring significant computing resources for reconstruction, mapping and analysis. This poster describes a demonstrator for delivering secure and transparent access to high-performance computing to the laboratory workbench using Grid technologies, in this case for 3D reconstruction from OPT microscopy.*

## 1. Introduction

Optical Projection Tomography [1], invented at the MRC Human Genetics Unit, can produce high-resolution 3D images of both fluorescent and non-fluorescent specimens up to 15mm in diameter. This technique is proving invaluable to biomedical research for the study of gene function, but is also far more computer intensive than previous forms of microscopy.

The researcher may want to analyse many specimens in one session so high throughput computing is important. The Grid [2] can provide a mechanism for accessing a variety of resources in the lab or at a remote site. In addition, the Grid must ensure that data security is paramount as the data may relate to novel scientific or commercial results or, more importantly in the clinical setting, involve patient confidentiality.

## 2. Harnessing the Grid

Three main components of the Globus Toolkit v2.0 [3] were used to implement a Grid version of the OPT reconstruction process:

- **GSI:** security, authorisation, authentication;
- **GRAM:** resource allocation, job submission;
- **GASS:** data transfer.

In the demonstrator, a X11/Motif GUI (OPTControl) directs the reconstruction process. Important parameters can be altered, and test reconstructions generated quickly, before a full reconstruction is started. OPTControl is a Globus client and carries out requests using the OPTGlobus interface: an API for transferring data files and for submitting properly formed Globus job requests using the OPT parameters. This request is made to run a parallel version of the OPTRecon reconstruction program (developed for this project using C and MPI) on a remote server. When this is completed, the reconstruction is transferred back to the client for the researcher to view.

## 3. Conclusions

This demonstrator achieved the goals set:

- High performance parallel computing has reduced the 5 hour compute time to 15 minutes.
- The Grid protocols could be used to deliver secure resource access to the laboratory bench.

A typical scenario for data analysis will include the primary data capture and reconstruction but will also require mechanisms for visualisation, virtual reality, data mining, data mapping and simulation modelling. These all demand access to significant computational resources via high speed secure network links – we can utilise the Grid to make this possible.

## 4. References

[1] J. Sharpe, U. Ahlgren, P. Perry, W. Hill, A. Ross, J. Hecksher-Sorenson, R. Baldock, and D. Davidson, "Optical Projection Tomography as a Tool for 3D Microscopy and Gene Expression Studies", *Science*, vol 296, April 19, 2002, pp. 541-545.

[2] I. Foster, C. Kesselman, and S. Tuecke, "The Anatomy of the Grid: Enabling Scalable Virtual Organizations", *Intl. J. Supercomputer Applications*, vol. 15(3), 2001.

[3] I. Foster, and C. Kesselman, "Globus: A Metacomputing Infrastructure Toolkit", *Intl. J. Supercomputer Applications*, vol. 11(2), 1997, pp. 115-128.

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