A Collaboratory for Microscopic Digital Anatomy:

Remote Access to the San Diego MIR IVEM and High Performance Computing Resources

Mark H. Ellisman
University of California, San Diego

Philip J. Mercurio
San Diego Supercomputer Center

The increased availability of High Performance Computing and Communications (HPCC) offers scientists the potential for effective remote interactive use of centralized, specialized, and expensive instrumentation and computers. The goal of this project is to design and implement a collaborative computational environment, or Collaboratory for Microscopic Digital Anatomy (CMDA), providing a researcher at a remote site distributed interaction with unique instrumentation for the acquisition and manipulation of images of biological structure. The initial focus will be on the development of an integrated system for remote interactive acquisition and analysis of 2- and 3-dimensional light and electron microscopic data from state-of-the-art digital image acquisition systems. To accomplish this task, a multidisciplinary team representing several national laboratories has been assembled. Participants in the CMDA project include computer scientists specializing in HPCC, volume visualization, and visual image management, and biologists with expertise in computer-aided light and electron microscopy.

The main test-bed instrument in the first phases of the CMDA project will be an Intermediate High Voltage Electron Microscope (IVEM) that has been specially designed for digital acquisition of three dimensional data from biological specimens. The remote user's system will provide interactive control of image acquisition from the IVEM from any laboratory on the Internet. As part of the project, work will be performed to further expand the imaging modes and improve automation of the instrument.

Telemicroscopy Prototype

Remote use of the SDMIR microscope, or "telemicroscopy", was prototyped in the Microscopist's Workstation (MWS) project during 1992, and demonstrated as part of the Showcase exhibit at Siggraph that year. We established a number of criteria for this first phase of the CMDA project. We decided early-on that we would not assume the availability of real-time video imagery from the microscope, since even a relatively short lag in interaction would lead to difficulty in driving the microscope. Instead, we present the user with a pre-collected survey of the specimen, calibrated so that requests for image acquisition can be placed relative to features in the survey. In this manner, the microscope is never driven "blind"—the user always has a reference image. In addition to new mosaic images, the user can request tomograms, which are rendered and sent to the MWS for display as animations. The reference images are annotated to provide a visual database of acquired images and animations.

The primary application running on the MWS is **GridBrowser**, which supports the display, measurement, and analysis of mosaic images of the specimen (grid) loaded into the microscope. GridBrowser can also play back animations resulting from computed tomography renderings. It affords the specification and display of the parameters related to image capture and tomography, and allows the user to place requests to other programs in the MWS network to capture data. In addition, two users running GridBrowser on separate workstations can exchange coordinate information, in support of cooperative work.

References

[Merc92a] Mercurio, P.J., Elvins, T.T., Young, S.J., Cohen, P.S., Fall, K.R., and Ellisman, M.H. "The Distributed Laboratory: An Interactive Visualization Environment for Electron Microscopy and Three-Dimensional Imaging", *Communications of the ACM*, Volume 35, Number 6, June, 1992, pp. 54-63.

[Merc92b] Mercurio, P.J., Elvins, T.T., and Young, S.J. *The Microscopist's Workstation*, Proceedings of Visualization '92, October, 1992, Boston.