$9.4 Million NSF Grant Backs UCSB-Led Effort In Bio-Image Informatics

October 3, 2003

Santa Barbara, Calif. -- The National Science Foundation (NSF) has awarded a $9.4 million grant to a research project led by University of California at Santa Barbara (UCSB) electrical and computer engineering professor Bangalore Manjunath. The five-year grant, one of eight the NSF conferred through its Information Technology Research (ITR) program, provides $6.9 million to UCSB and $2.5 million to Carnegie Mellon University (CMU), where the principal investigator is Robert Murphy, professor of biological sciences and biomedical engineering. Researchers at the University of California at Berkeley and at the Massachusetts Institute of Technology (MIT) are also participants.

Stuart Feinstein, serving as director of UCSB's Neuroscience Research Institute, describes the problem the research aims to solve: "Biological research efforts are generating enormous quantities of data and analyzing it manually."

By "manually" Feinstein means "by person" and "by eye." Research labs throughout the world are generating vast quantities of photographic images of cells and tissues. Those representations are currently analyzed via the researchers' eyes looking at the images.

According to the winning proposal, "Next Generation Bio-Molecular Imaging and Information Discovery," the project's mission is "to develop new information processing technologies appropriate for extracting detailed understanding of biological processes from images depicting the distribution of biological molecules within cells or tissues."

Said Feinstein, "Not only do we now analyze those images one at a time by eye, but there's also no way to sort through them or do a search. There is a tremendous amount of valuable information--applicable both to basic science and to clinical situations--and we are not harvesting nearly what we could if we had computer-assisted methods to do it."

"Bioinformatics," said Manjunath, "is mostly data driven, and most of the data creating excitement recently is in the form of linear strands of DNA -- the Human Genome Project. The information in that data is one-dimensional -- i.e., conveyed in the sequence of the four nucleotides A, C, G, and T. The information in the pictures we are trying to devise computerized methods for analyzing is two- and three- and more dimensional because we are looking for patterns defined by more than one parameter ('one' being sequence of nucleic acids).

"Right now there are no tools to manage such image modalities -- to store them (given the sources) and then to perform a mining operation and to bring the results onto the screen," said Manjunath.

"We are trying to understand how we can detect the key interesting structures that the expert biologist can do just by looking. So we are developing sophisticated image analysis pattern recognition programs."

Two other UCSB neuroscientists are also involved in this project. Steven Fisher specializes in retina cell biology and has made thousands of images examining cell types and proteins. The project aims at storing and enabling searches of such "image-banks" so that patterns can be revealed. Leslie Wilson, a molecular cell biologist, specializes in understanding the role of the cytoskeleton in normal cells as well as in cancerous cells and neurodegenerative diseases.

"If we are successful," said Feinstein, "we will be able to find correlations through vast databases that we wouldn't have a prayer of finding by eye."

Said Manjunath, "My group is looking at problems related to image analysis for large collections of these images. We are asking how to go about characterizing information content in those images. We are asking what are the kinds of image attributes that are helpful for characterizing the underlying patterns. This is a formidable information processing problem."

Digital Library for Bio-Molecular Images

The project will establish a digital library for bio-molecular images. "Pattern recognition and data-mining tools, together with new powerful methods for indexing, data modeling, and collaboration will come together in creating this unique infrastructure," according to Manjunath. The database and its integration with other sources of biological data will greatly facilitate image bioinformatics and large-scale biology.

There are three main thrusts to the project:

Creating methods for image analysis and pattern recognition and data mining. This effort is led by Kenneth Rose, a UCSB electrical and computer engineering professor, whose research expertise is in the disciplines of information theory, pattern recognition, and general information processing.
Creating databases to support image bio-informatics. This work is led by computer science professor Ambuj Singh, whose research interests include bio-informatics and databases.
Designing new imaging instrumentation that can scan samples at faster rates and generate better quality images. Sanjoy Banerjee, a professor of chemical and mechanical engineering, leads this research at UCSB.

NOTE: Professor Manjunath can be reached by phone (805) 893-7112 and by e-mail manj@ece.ucsb.edu; Professor Feinstein at (805) 893-2659 or 8382 and feinstei@lifesci.ucsb.edu.

Images

Media Contact

Tony Rairden
trairden@engineering.ucsb.edu
805.893.4301