

Researchers Develop Powerful Tools to Improve Medical Imaging Analysis

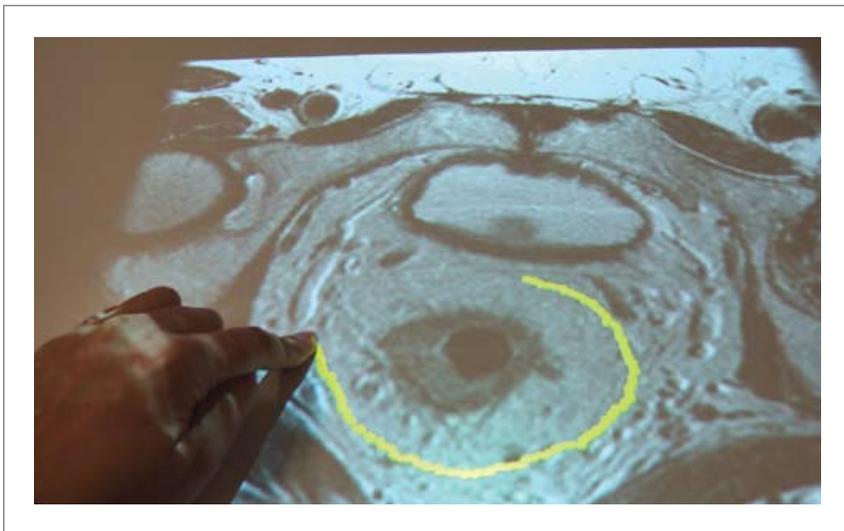
Medical image analysis researchers face many challenges in helping clinicians detect and monitor cancer tumors. A team of computer scientists at the University of Oxford's e-Research Centre in the UK is developing software tools that will make it easier to share and reuse medical image analysis data and algorithms

Each year, an estimated 1.1 million people worldwide are diagnosed with colorectal cancer and more than 600,000 people die from the disease, according to the American Cancer Society. It is the third most common cancer and third leading cause of cancer death. What's more, colorectal cancer often metastasizes to the liver—and liver cancer is another leading killer.

Clinicians use a variety of medical imaging technologies to detect colorectal cancer, determine the stage of the disease and monitor a patient's response to treatment. These technologies include magnetic resonance imaging, ultrasound, computerized tomography and a combination of computerized tomography and positron emission tomography.

But determining the size, location and configuration of colorectal and liver cancer tumors—a critical step prior to and during treatment—through a process called “image segmentation and registration” can pose significant challenges for radiologists. The images are often low resolution and highly textured—for instance, tumors appear with relatively poor contrast to their surroundings, which makes it difficult to distinguish their boundaries.

Because the types of cancer tumors and their surroundings are so varied, medical image analysis researchers are continually working to improve image segmentation and registration algorithms. Segmentation algorithms are used to identify tumor shapes and boundaries within a medical image. Typically, this segmentation has to be



Researchers at the Oxford e-Research Centre are investigating the use of multi-touch and multi-user computer technologies to make it easier for clinicians to analyze images of colorectal and liver cancers.

Fast Facts

Project Principals:

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Sir Michael Brady, professor of engineering science, University of Oxford

Dr. Fergus Gleeson, radiologist, Department of Surgery, Churchill Hospital, Oxford

Web Site:

www.oerc.ox.ac.uk

www.oerc.ox.ac.uk/research/lowering-the-barriers-to-cancer-imaging

Microsoft Technologies:

SharePoint Server 2007

Windows® Workflow Foundation

Project Trident Scientific Workflow Workbench

Silverlight™

Windows Presentation Foundation

Microsoft External Research

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performed on a very large number of image “slices”—a complex and time-consuming process.

Depending on the type of tumor and its surroundings, clinicians need to try a range of image segmentation algorithms to assess which ones provides the best results. If one algorithm doesn't give a good result, they move on to another. Sometimes they need to compare results from a variety of algorithms.

At present, however, it is very difficult for researchers to share or reuse medical image data and algorithms that were developed by other researchers.

With software, technical and financial support from Microsoft External Research, a team of computer scientists at the Oxford e-Research Centre is developing software tools to help clinicians and researchers overcome these limitations. “What we'd like to do is make it easier for them to store and share medical images and algorithms,” says Anne Trefethen, a professor of scientific computing at the University of Oxford and director of the Oxford e-Research Centre.



“The basic idea of this project is to take these images and algorithms and provide the mechanisms for researchers and clinicians to share and reuse them—in a platform-independent way.”

—María Susana Avila-García,
research associate, Oxford e-Research Centre

Trefethen and María Susana Avila-García, a computer scientist at the Oxford e-Research Centre, have been collaborating with medical imaging researchers, clinicians and other medical experts at Oxford's John Radcliffe and Churchill hospitals on a Microsoft-funded project called Lowering the Barriers to Cancer Imaging. While the project is initially focused on colorectal and liver cancer, the tools and methods that Trefethen and Avila-García are working with could eventually be applied to other types of cancer imaging.

One aspect of the team's work is adapting multi-touch and multi-user computer technologies to analyze images of colorectal and liver cancers. For instance, the researchers are experimenting with the use of multi-touch interfaces in multidisciplinary team meetings—where pathologists, radiologists, oncologists, surgeons and specialized nurses gather in a room to analyze medical images from cancer patients and discuss treatment strategies. They are finding that multi-touch, multi-user interfaces can be more efficient and effective for analyzing medical images.

During the course of their research, however, “We realized that what [the cancer researchers and clinicians] really needed was a framework that will enable them to store and share information, images and algorithms,” says Avila-García. As it happened, Microsoft Research was already working

with The British Library to develop a powerful new “virtual research environment” called the Research Information Centre (RIC). The goal of that project is to create an easy-to-use browser interface that enables research partners to find, store, track, share and discuss all the components of a project, including data, proposals, papers, references, bookmarks and findings.

Built on the Microsoft® SharePoint® Server 2007 platform, the prototype version of the RIC was geared toward biomedical research. But the base architecture is designed so that it can be adapted to other scientific research domains. One of the key strengths of the RIC will be its interoperability. Research teams will be able to customize the interface, adding tools and features that meet their needs.

In 2009, Trefethen's team received funding from the Joint Information Systems Committee (JISC), an organization that provides technology support to university researchers in the UK, to extend the RIC to create a virtual research environment specifically for cancer image research and analysis. Microsoft External Research is providing technical support.

The plan is to incorporate another new Microsoft Research tool—the Project Trident Scientific Workflow Workbench—into the RIC platform. By combining workflow and visualization technologies, Project Trident makes it easier for scientists to manage and analyze complex datasets.

Trefethen and Avila-García say combining the RIC and Project Trident will provide a powerful new tool for cancer researchers and clinicians.

For example, Trefethen says, medical imaging researchers are continually developing and testing new algorithms for analyzing different types of cancers. “You can go and read about that research in a paper, but trying that algorithm out on your own sets of images can be incredibly difficult,” she says.

Reusing a previously developed algorithm to analyze a new image can be challenging because it might have been developed using specific imaging toolkits in a programming language the researcher is not familiar with, the image formats might be different or there might not be sufficient documentation on how to reuse the algorithm.

“The basic idea of this project is to take these images and algorithms and provide the mechanisms for researchers and clinicians to share and reuse them—in a platform-independent way—so they don't have to install all the tools, compilers and imaging toolkits,” says Avila-García. “They will be able to just go and use the algorithm in a very high-level way.”

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