Imaging Diseases in New Light

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Rheumatoid arthritis (RA) is an autoimmune disease that affects nearly 20 million people worldwide, striking young people as well as old, causing pain, stiffness, and swelling of the joints. Early diagnosis and treatment can slow or prevent joint damage and increase the likelihood of leading an active and full life.

Leading an international team of engineers, scientists, and physicians from Germany and the United States, Andreas Hielscher has developed a 3-D optical tomographic (OT) imaging system that displays disease activity in joints. "Shining light through the finger allows us to see the disease before X-rays can find any changes," explained Hielscher, showing the latest results from a recent clinical trial.

In another project that relies on the same harmless light transmission measurements, members of his laboratory have built an optical imaging system for the diagnosis of breast cancer. Breast cancer afflicts one in nine women during their lifetime and is the second leading cause of cancer deaths in women. Hielscher's patented imaging technology has been licensed by a New York company and promising clinical pilot studies using the new imager are underway.

Hielscher also employs OT imaging to localize green fluorescent proteins (GFPs), developed by Columbia's 2009 Nobel laureate Martin Chalfie. GFPs and their derivatives make it possible to see and monitor cell and tissue behaviors during development, including observation of cancerous tumors in vivo. Hielscher and his colleagues use GFP to study the growth of cancers in the stomach, liver, and brain. Most recently, he is applying this technology to monitor drug effects in difficult-to-treat early childhood cancers, such as neuroblastoma and Wilms tumors.

Before joining Columbia Engineering in 2001, Hielscher was a postdoctoral fellow at Los Alamos National Laboratory and was on the faculty at the State University of New York Downstate Medical Center. Now he directs Columbia's Biophotonics and Optical Radiology Laboratory, which works towards establishing optical tomography as a viable biomedical imaging modality. To this end, Hielscher's team is developing state-of-the-art imaging hardware and software that provide 3-D distributions of physiologically relevant parameters in biomedical systems. The work of the laboratory is supported, among others, by the National Institute of Arthritis and Musculoskeletal and Skin Diseases, the National Institute of Biomedical Imaging and Bioengineering, the National Cancer Institute, and the New York State Foundation for Science, Technology and Innovation.

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