Optoelectronic Integrated Circuits for Diffuse Optical Tomography

Personnel

W. Giziewicz and C. G. Fonstad, Jr. in collaboration with S. Prasad and D. Brooks

Sponsorship

NSF

In August we began a three year collaborative research program with Professors Dana Brooks and Sheila Prasad of Northeastern University applying and using our technologies for monolithic optoelectronic integration to address problems and needs of biomedical research and diagnosis. Specifically we will be working to monolithically integrate light sources and detectors with complex high density, high performance electronic circuitry to realizate of a wide variety of sensors and measurement arrays for medical research and diagnostics.

We have identified as an initial vehicle for applying this technology a integrated source/detector array for Diffuse Optical Tomography (DOT). The proposed unit will permit DOT observations with a resolution exceeding that of present techniques and will lead to the use of DOT in procedures and situations in which it is currently unfeasible.

Stated in the most general terms, the NSF-supported effort is directed at developing, applying, and making available a technology to monolithically integrate III-V optical emitters and detectors with commercially fabricated, custom-designed integrated circuits to produce high resolution two-dimensional arrays of individually addressable smart excitor/sensor pixels tailored for biomedical research applications and studies. A representative pixel might measure 250 to 500 microns on a side, and contain, for example, a diode light emitter (LED or laser), one or more light sensors, and a significant amount of electronic signal processing circuitry. This basic unit is a building block from which a wide variety of biomedical optical measurement systems can be realized in a very rugged, compact chip-size format. It promises to lead, in the future, to totally new sensor geometries and measurement procedures.

The challenges that the program will face include continuing development of the OEIC technology and adapting this technology for biomedical research; developing suitable signal processing algorithms and designing compact, high performance signal processing circuit arrays in the relevant electronics technologies to interface with the optoelectronic devices; and suitably packaging the OEIC chips for their biomedical utilization.

The project team will be aided in this effort by its strong links with the North-eastern University Center for Subsurface Sensing and Imaging Systems, the Massachusetts General Hospital NMR Center, the Univeristy of Utah NIH/NCRR Center for Bioelectric Field Modeling, Simulations and Visualization, and the MIT Microsystems Technology Laboratory, and by integrated circuit processing support from Vitesse Semiconductor Corporation.