

Improving Microarray Analysis with Hyperspectral Imaging and Multivariate Data Analysis

By combining hyperspectral imaging and patented multivariate statistical analysis, researchers at Sandia National Laboratories are able to improve the quality and information content in DNA microarray technology. DNA microarrays are tools for understanding differential gene expression, which is the translation of the information contained in a cell's DNA into the proteins that perform critical cellular functions. The microarrays themselves are small glass slides that contain thousands of regularly arranged samples of genes. To collect information on gene expression, researchers attach fluorescent dye tags to the DNA and then scan the tags on the microarrays to determine the genes being expressed or the presence of background "noise" or contaminants. Current commercial microarray scanners use univariate methods to quantify a small number of fluorescent dyes on printed microarray slides.

With funding from the Sandia-led Genomes to Life investigation, Sandia's Laboratory Directed Research and Development program, and the W. M. Keck Foundation, Sandia researchers have designed, constructed, and characterized a new hyperspectral microarray scanning system that collects a full fluorescence dye-label emission spectrum throughout the microarray. When combined with Sandia-patented multivariate curve resolution (MCR) algorithms, the new system can identify, model, and correct gene expressions for unknown emissions, increase throughput by accommodating many spectrally overlapped labels in a single scan, and improve sensitivity, accuracy, precision, dynamic range, and reliability. MCR analysis of a hyperspectral image generates the pure-component emission spectra for the fluorescent dyes, the glass slide, and any contaminants, as well as creating corresponding concentration maps of the DNA labels, which are used to obtain an accurate image of the DNA labels and assess the effect of any contaminants on gene expression data.

Sandia has also employed statistically designed microarray experiments to identify and eliminate experimental error sources in the microarray technology. The hyperspectral scanner is currently being modified to allow imaging of many fluorophores in cells and tissue in three dimensions.

Media Interest: No

Point of Contact: David Haaland, Sandia National Laboratories, 505-844-5292, dmhaala@sandia.gov