STANFORD UNIVERSITY
DEPARTMENT OF STATISTICS

DEPARTMENTAL SEMINAR

4:15 p.m., Tuesday, July 15, 2008
Sequoia Hall Room 200
(Cookies at 3:45 in 1st Floor Lounge)

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Some Statistical Problems in Spectroscopy and Hyperspectral Imaging

Every material has a distinctive spectrum. The spectrum of a material tells us about its chemistry. Hyperspectral images produce a spectrum (represented as several hundred numbers) at each pixel in an image. So hyperspectral images enable us to map variations in chemistry.

The first hyperspectral scanners, built in the 1980s and 1990s, were designed for airborne applications, primarily for mineral, environmental and military applications. However, in recent years, hyperspectral microscopes and cameras have been developed and are being used for terrestrial applications in areas such as medical diagnosis, burns analysis and skin cancer, biosecurity, pharmaceuticals, forensics and in agribusiness.

A significant issue in hyperspectral imaging is that the spectra at many pixels in an image are actually mixtures of the spectra of the pure ingredients. My main focus over a number of years has been on developing fast and sophisticated algorithms and software for unmixing these spectra into their pure ingredients, both when the pure ingredients are known and when they are unknown. This has resulted in two software packages:

The Spectral Assistant (TSA), which has been incorporated into another CSIRO package, The Spectral Geologist, which itself has been sold to over 100 (mainly exploration and mining) companies around the world; and Iterated Constrained Endmembers (ICE), which has yet to be commercialized.

I will give an overview of the algorithms underlying TSA and ICE, and demonstrate their application to some mineral, biological and pharmaceutical data sets. Finally, I will discuss some unsolved statistical and computational problems associated with these packages.