Fast Algorithms for Image Segmentation

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Many automated procedures for extracting useful information from images rely on image segmentation as a first step. The goal of segmentation is to determine regions of the image that contain distinct objects of interest. In medical imaging, one application is to isolate the cross-sections of brain tissue from an MRI scan.

Although there are successful models for segmentation, they are often computationally very expensive, as they involve solving nonlinear partial differential equations that model moving interfaces. F. Gibou & R. Fedkiw, and B. Song & T. Chan made recent progress in this area. Motivated by ideas of B. Merriman, J. Bence, and S. Osher, we developed an algorithm that reduces the segmentation model of Mumford and Shah to the solution of a *linear* partial differential equation and simple thresholding. Since there are already mature numerical techniques for solving linear equations efficiently, this results in a very fast algorithm for image segmentation.

The three dimensional computation on the right for extracting the surface of the brain from volumetric MRI data involved a computational expense of about 20 fast Fourier transforms.