STANFORD UNIVERSITY

DEPARTMENT OF STATISTICS

DEPARTMENTAL SEMINAR

4:15 p.m., Tuesday, January 7, 2003
Sequoia Hall Room 200
(Cookies at 3:45 in 1st Floor Lounge)

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Are those currently fashionable edge-preserving smoothers quantitatively superior?

We consider the image de-noising problem from the point of view mathematical statistics. We study anisotropic smoothing methods which aim to recover images with sharp edges from noisy data. We derive the optimal anisotropic behavior, and show that the scale of the smoothing must be spatially variable - getting smaller near the edge – but also the anisotropy must be spatially variable -getting more anisotropic near edges, according to the scaling law that says that the effective width of the implicit smoothing kernel is the square of the effective length. It turns out that, despite reputation, none of the geometric diffusion techniques that we have studied exhibits the required behavior. At the same time, there exist several methods based on harmonic analysis with the required properties – including wedgelet thresholding and curvelet thresholding. To illustrate our point, we report the results of a careful analysis of median filtering, show that it is quantitatively outperformed even simple wavelet thresholding. We infer similar conclusions for other standard geometric diffusions. The implication is that there is a serious need for future developments of new geometric-diffusion de-noising techniques which exhibit proper adaptive anisotropy scaling and consequently improved de-noising.

Joint work with David Donoho.