FALL 2001 - MATH 285J SEMINAR: Applied Mathematics
Variational Methods & PDE’s for Image Analysis and Curve Evolution

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PLAN & BIBLIOGRAPHY (tentative)

0 Introduction

1. Image processing tasks
2. Applications
3. Representation of images in the continuous and discrete case, gray level and color images, degradation operators (blur), noise, gradient magnitude

1 Image Restoration

1. Variational methods: Total Variation of Rudin-Osher-Fatemi and related models [1], [2], [3], [4]
2. Anisotropic diffusion of Perona-Malik [5], nonlinear diffusion [6], [7], image-enhancement using shock filters of Osher-Rudin [8]
4. Other related topics (if time permits): half-quadratic regularization [4], [10], [2], blind deconvolution Chan-Wong [11], higher order variational models for image restoration [2], [12].

The following topics will be introduced and discussed: functions of bounded variation and functionals on the BV space, existence and uniqueness, Euler-Lagrange equation, discretization by finite differences.
2 Image Segmentation

2. The weak formulation for the Mumford and Shah problem by Dal Maso-Morel-Solimini [14]
3. Approximations to the weak formulation by finite differences Chambolle [16], [17], elliptic approximations by $\Gamma$– convergence by Ambrosio-Tortorelli [15]
4. Region growing and merging [18], other numerical considerations

3 Curve and Surface Evolution in Image Processing

1. Geometric curve and surface evolution (introduction)
2. Level set formulation of Osher-Sethian [19]
3. Viscosity solutions [20], [21]
4. Object detection by snakes [22], active contours and level sets [23], [24]

Books and Lecture Notes

References


