FALL 2001
MATH 285J SEMINAR Applied Mathematics

Variational Methods & PDE’s for Image Analysis and Curve Evolution

Instructor: Luminita A. Vese
Office: MS 7354
Office hours: MWF 2-3pm or by appointment.
E-mail: lvese@math.ucla.edu
Lecture Time and Location: MWF 1.00-1.50PM, in MS 5217.
Class Web Page: http://www.math.ucla.edu/~lvese/285j.1.01f
Enrollment Restriction: Graduate Students
Units: 4.0

Course Description:
The first part of the lecture will be devoted to restoration of images. We will present the Rudin-Osher-Fatemi model (they were the first to propose the minimization of the total variation); we may also discuss other related and more recent methods, by Chambolle-Lions, Aubert-Vese, Dibos-Koepfler, Chan-Wong. We will present the mathematical framework to solve these problems (the space of functions of bounded variation $BV$), as well as numerical discretizations. Then, we will describe other PDE models of anisotropic diffusion (Perona-Malik, Alvarez-Guichard-Lions-Morel).

The second part of the lecture will be devoted to segmentation. We will discuss the Mumford-Shah model and related minimizations of functionals depending on jumps and elliptic approximations (Dal Maso-Morel-Solimini, Chambolle, Ambrosio-Tortorelli), and the mathematical framework for these problems, in the space $SBV$ of special functions of bounded variation, together with numerical techniques.

The last part of the lecture will be devoted to curve evolution problems for image processing: geometric PDE’s (e.g. motion by mean curvature), snakes, active contours, presented in the level set framework of Osher-Sethian and the theory of viscosity solutions.

Note: Problems, exercises and short numerical projects will be assigned from time to time. Papers can be read by the students and presented in class.

Plan & References: See the Class Web Page

Software:
MegaWave is a free software intended for image processing. It has been created by Jean-Michel Morel and his group (CMLA at E.N.S. Cachan, and CEREMADE, University of Paris IX-Dauphine, France).
MegaWave is installed in the Mathematics Department at UCLA! (thanks to François Malgouyres).

Matlab: images/images (Image Processing Toolbox), images/imdemos (demos and sample images).