MS10: Variational Models and Their Fast Algorithms in Mathematical Imaging

Alternating Direction Method of Multiplier for Elastica Denoising

Sung Ha Kang, *Georgia Institute of Technology*

Inspired by recent numerical developments, we propose a new version of alternating direction method of multiplier (ADMM) for Euler's Elastica base denoising model. The main contribution is to design a simple and fast method, which is also easy to choose parameters.

Fast Decentralized Gradient Descent Method

Xiaojing Ye, *Georgia State University*

We consider the decentralized consensus optimization problem on a connected network where each node privately holds a part of objective function and data. The goal is to find the minimizer for the whole objective function while each node can only communicate with its neighbors during computations. We present a fast decentralized gradient descent method whose convergence does not require diminishing step sizes as in regular decentralized gradient descent methods, and prove that this new method can reach optimal convergence rate of $O(1/k^2)$ where k is the communication/iteration number.

A Decoupled Unconditionally Stable Numerical Scheme for the Cahn-Hilliard-Hele-Shaw System

Daozhi Han, *Florida State University*

We propose a novel decoupled unconditionally stable numerical scheme for the simulation of two-phase flow in a Hele-Shaw cell which is governed by the Cahn-Hilliard-Hele-Shaw system with variable viscosity. The temporal discretization of the Cahn-Hilliard equation is based on a convex-splitting of the associated energy functional. Moreover, the capillary forcing term in the Darcy equation is separated from the pressure gradient at the time discrete level by using an operator-splitting strategy. Thus the computation of the nonlinear Cahn-Hilliard equation is completely decoupled from the update of pressure. Finally, a pressure-stabilization technique is used in the update of pressure so that at each time step one only needs to solve a Poisson equation with constant coefficient. We show that the scheme is unconditionally stable. Numerical results are presented to demonstrate the accuracy and efficiency of our scheme.

A Variational Model for Shape from Shading

Wei Zhu, *University of Alabama, Tuscaloosa*

Shape from shading (SFS) is a classic and fundamental problem in image processing. It aims to reconstruct the 3D shape of a surface from a given 2D irradiance image, which is a highly ill-posed problem. In this talk, we will address a novel variational model that employs mean curvature of image surface for the SFS problem. We will also discuss some features of this model and the fast algorithm using augmented Lagrangian methods.