FUDAN UNIVERSITY

Applied Math Ph.D. Seminar

SSNCVX: A primal-dual semismooth Newton method for convex composite optimization problems

Speaker: Zhanwang Deng (Peking University)

Time: 2026-11-19, 16:10 to 17:00

Location: Rm 1801, Guanghua East Tower

Advisor: Zaiwen Wen (Peking University)

Abstract: We propose a primal-dual semismooth Newton framework for solving a broad class of structured convex composite optimization problems with proximable nonsmooth terms and simple structured constraints. By leveraging augmented Lagrangian duality, we reformulate the original problem as a saddle-point system and characterize its optimality conditions through a semismooth system of primal-dual nonlinear equations. The proposed framework combines modular proximal and generalized-Jacobian evaluations, primal-dual residual formulations, and structure-exploiting linear algebra into a unified and reusable solver architecture. This design enables efficient handling of diverse nonsmooth structures while allowing flexible model extensions through interface-level updates.

The resulting algorithm employs a single-loop semismooth Newton scheme to simultaneously update primal and dual variables. We further establish convergence guarantees by exploiting the underlying semismooth structure, including fast local convergence under mild regularity conditions without relying on overly restrictive assumptions such as strict complementarity or nonsingularity. Extensive numerical experiments demonstrate that the proposed framework achieves competitive performance against existing semismooth Newton augmented-Lagrangian methods and significantly outperforms first-order approaches on a variety of structured convex optimization problems.