Nonsmooth Problems with Applications in Mechanics
Bedlewo, Poland, June 17-22, 2023

Mixed Finite Element Methods for Hemivariational Inequalities in Fluid Mechanics

Weimin Han

Department of Mathematics, University of Iowa
Iowa City, IA 52242, USA

weimin-han@uiowa.edu

Abstract: This talk focuses on analysis of mixed finite element methods of hemivariational inequalities arising in fluid mechanics. Due to the low solution regularity and the inequality feature of the problems, low-order velocity-pressure finite element space pairs are preferred. It is well-known that the key to the success of mixed finite element methods is the validity of the discrete inf-sup condition of the finite element space pairs. Yet, the discrete inf-sup condition is not satisfied by the standard conforming P_1-P_0 element pair and the continuous P_1-P_1 element pair; stabilization of the pairs is usually used. In analysis of pressure stabilized mixed finite element methods, we introduce a new framework of mixed hemivariational inequalities and provide well-posedness results based on basic knowledge from functional analysis. The well-posedness results can be applied to the continuous level Stokes and Navier-Stokes hemivariational inequalities, and to their finite element approximations. Optimal order error estimates are derived for the mixed finite element methods for solving the Stokes and Navier-Stokes hemivariational inequalities, and numerical examples are presented to show the performance of the methods.