We consider a system of nonlinear partial differential equations modelling a viscous incompressible chemically-reacting generalized Newtonian fluid. The governing system

Partial Differential Equations and Applied Mathematics Seminar

Title Finite Element Approximation of Generalized Newtonian Fluids with Concentration-Dependent Power-Law Index

Speaker 고승찬 박사

Affiliation Free University of Berlin

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Location Science Building #225 Yonsei University

Abstract

We consider a system of nonlinear partial differential equations modelling the motion of an incompressible chemically reacting non-Newtonian fluid. The governing system consists of a convection-diffusion equation for the concentration and the generalized Navier-Stokes equations, where the viscosity coefficient is a power-law-type function of the shear-rate, and the power-law index depends on the concentration. This system of nonlinear partial differential equations arises in mathematical models of the synovial fluid found in the cavities of movable joints. We first discuss the existence of weak solutions of the model based on monotone operator theory and Acerbi-Fusco Lipshcitz truncation method. Then we construct a finite element approximation of the model and perform the mathematical analysis of the numerical method. Key technical tools include discrete counterparts of the Bogovskii operator, De Giorgi-type regularity theorem, and the Lipschitz truncation of Sobolev functions, in function spaces with variable-integrability exponents.

Yonsei University Department of Mathematics