MS7: Optimal Control, Optimization, Inverse Problems and Numerical Simulations with Applications I

Global Well-Posedness and Uniform Stability of a Nonlinear Thermo-Elastic PDE System

Xiang Wan, *University of Virginia*

We consider a nonlinear thermoelastic system defined on an open bounded set Ω with simply supported boundary conditions imposed on $\Gamma = \partial\Omega$. The background will be introduced first, followed by reviewing the work on the case $\gamma = 0$. Our challenge is to consider the case $\gamma > 0$. From a mathematical point of view the most important message is that the analyticity and maximal regularity of the associated linear system are gone. We will show the techniques to overcome this difficulty.

Optimal Control of a Parabolic PDE System Arising in Wound Healing

Stephen Guffey, *Western Kentucky University*

We consider a control problem for a system of four parabolic PDEs. The model described the behavior of oxygen, neutrophils, bacteria, and chemoattractant in a chronic wound, where the control represents the case of oxygen therapy. We wish to find the optimal level of supplemental oxygen to minimize both the bacteria count in the wound as well as the supplemental oxygen supplied. We discuss the existence of solutions for our system, the existence of an optimal control for our model, as well as the classification of the optimality system.

Constrained Optimization for Random Data Identification Problems

Catalin Trenchea, *University of Pittsburgh*

We present a scalable, parallel mechanism for stochastic identification/control for problems constrained by PDEs with random input data. Several identification objectives are discussed that either minimize the expectation of a tracking cost functional or minimize the difference of desired statistical quantities in the appropriate L^p norm. The stochastic parameter identification algorithm integrates an adjoint-based deterministic algorithm with the sparse grid stochastic collocation FEM approach. The proof of the error estimates uses a Fink-Rheinboldt theory.

Numerical Methods for Fractional Order Systems

Mehdi Vahab, *Florida State University*

Simulation of fractional order systems and controllers needs evaluation of fractional order operators. We will discuss the properties and applications of the Grnwald-Letnikov, Riemann-Liouville, Caputo and Riesz fractional derivatives. Numerical evaluations of these operators and numerical algorithms for their accurate calculations will be presented. We will show the effect of the order of fractional derivatives for different types of PDEs and show the results for these systems in which solution may develop discontinuities.