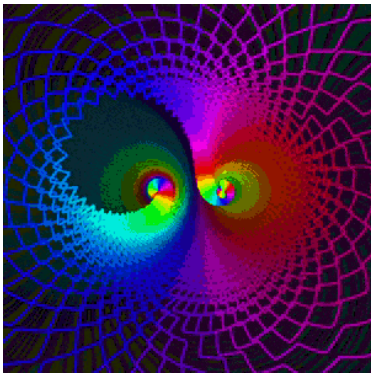
University of Puerto Rico Mayaguez Campus
Faculty of Arts and Sciences
Department of Mathematical Sciences
call box 9000, Mayagüez, P.R. 00681

THE DEPARTMENT OF MATHEMATICAL SCIENCES PROUDLY PRESENTS

COLLOQUIUM

January-May, 2023

Numerical methods for PDE-constrained optimization problems governed by hyperbolic equations



Dr. Andreas Mang
University of Houston

Mar-28-2023
10:30 am

Abstract: In this talk, we will discuss efficient numerical algorithms for the solution of PDE-constrained optimization problems governed by hyperbolic transport equations. We will consider applications in medical imaging, and, in particular, an inverse problem referred to as image registration. Here, we are given two images as inputs and seek a spatial transformation that maps points in one image (the template image) to corresponding points in the other image (the reference image). We limit the space of admissible maps y to the group of diffeomorphisms parameterized by smooth, time-dependent velocity fields v. We will explore different formulations and discuss various strategies for their numerical solution. In particular, we will augment the considered hyperbolic PDE constraint that models the transport of image intensities by adding incompressibility constraints as well as an Euler-Poincaré equation of the diffeomorphism group. Our contributions are in the design of numerical methods and computational kernels that scale on heterogeneous, high-performance computing platforms. Our solvers are based on state-of-the-art algorithms to enable fast convergence and short runtime. We consider adjoint-based methods for optimization that exploit first- and second-order derivative information. We will showcase results for real and synthetic data to analyze rate of convergence, time-to-solution, numerical accuracy, and scalability of our solvers. As a highlight, we will showcase results for a GPU-accelerated implementation termed CLAIRE that allows us to solve clinically relevant 3D image registration problems with high accuracy in under 5 seconds on a single GPU and scales up to 100s of GPUs.

Enlace:
meet.google.com/urm-rhmx-dhw

Ph.D. in CISE
University of Puerto Rico