NORTH CAROLINA STATE UNIVERSITY

OPERATIONS RESEARCH PROGRAM
SEMINAR SERIES

March 18th, 2024
4:30PM-5:45PM

In-Person: 4290 Fitts-Woolard Hall
Zoom details – bottom of page

Dr. Dávid Papp

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North Carolina State University
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Title

Searching for Monostatic Polyhedra:
Computer-assisted Theorem Proving with Convex Optimization

Abstract

The seminar concerns an unusual application of operations research: the stability of convex polyhedra, a fundamental question in 3-dimensional geometry whose study goes back to the 1960s. A convex body is called *mono-(un)stable* if it has a unique (un)stable equilibrium. It is *monostatic* if it belongs to either of the two classes, and *mono-monostatic* if it belongs to both. Such convex bodies are surprisingly difficult to construct: the *Gömböc*, constructed by Domokos and Várkonyi in 2006, is the first known mono-monostatic, homogeneous convex body. Several monostable polyhedra have also been found, but the minimal number of vertices (faces, edges) such a polyhedron must have is unknown. Mono-instability is even less understood; mono-monostatic homogenous polyhedra have not been explicitly constructed. In this seminar we will show not only how we can use optimization to *construct* mono-unstable polyhedra (the less surprising application), but also how to rigorously *prove the non-existence* of such polyhedra with few vertices. The talk will not assume any prior familiarity with the subject, only standard OR 505 material.

Biography

Dr. Dávid Papp

Dr. Dávid Papp is an associate professor in the Department of Mathematics at NC State. After studying at the Budapest University of Technology and Economics in Hungary, he obtained his PhD in operations research at Rutgers University in 2011. Before joining NC State, he worked at Northwestern University and at the Massachusetts General Hospital. His research focuses on the design, analysis, and implementation of algorithms for solving large-scale optimization problems and their applications in healthcare, engineering, and statistics. His radiotherapy optimization algorithms are built into two clinical treatment planning software used worldwide (Philips Pinnacle and RaySearch RayStation). He received an NSF CAREER Award in 2019 for his computational mathematics research and the Mehrotra Award from the INFORMS Health Applications Society in 2021 for his work on radiation therapy.

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