Mathematics Colloquium

Deflated Continuation: A bifurcation analysis tool for Nonlinear Complex Dynamical Systems

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Friday, October 25, 2019
4:10 – 5 p.m.
Building 53 Room 206

Abstract

Continuation methods are numerical algorithmic procedures for tracing out branches of fixed points/roots to nonlinear equations as one (or more) of the free parameters of the underlying system is varied. On top of standard continuation techniques such as the sequential and pseudo-arclength continuation, we will present a new and powerful continuation technique called the deflated continuation method which tries to find/construct undiscovered/disconnected branches of solutions by eliminating known branches. In this talk we will apply this method to the Nobel-Prize winning area of Bose-Einstein Condensates (2001 Nobel Prize in Physics). At first, we will explore the configuration space of solutions of an one-component Nonlinear Schrödinger (NLS) equation in two spatial dimensions. We will present novel nonlinear steady states that had not been reported before and discuss bifurcations involving such states. Subsequently, we will focus on a two-component NLS system (describing interactions between different species of atoms in a condensate) and discuss about recent developments by using the deflated continuation method where the landscape of solutions of such a system is far richer. A discussion about the challenges in the two-component setting will be offered and a summary of open problems particularly suited for student involvement will be emphasized.

About the speaker: Efstathios (Stathis) Charalampidis is currently an Assistant Professor in the Mathematics Department at Cal Poly San Luis Obispo. His research focuses on studies of complex systems originating from problems in mathematical physics, condensed matter physics, materials science, and fluid mechanics. Specifically, he has been developing novel analytical and computational techniques for studying the existence, stability and spatio-temporal evolution of nonlinear waves in a broad spectrum of applications, ranging from dynamical systems describing the formation of solitary patterns in materials science to matter waves in Bose-Einstein condensates and rogue waves. Before joining Cal Poly, he was a Lecturer and Chief Undergraduate Advisor for Mathematics majors (2018-2019), Visiting Assistant Professor (2015-2018) and Postdoctoral Research Associate (2013-2015) at UMass Amherst in the group of Professor Panayotis Kevrekidis. Stathis earned his PhD in Applied Mathematics from the Department of Mathematical, Physical and Computational Sciences at Aristotle University of Thessaloniki, Greece. His PhD dissertation, entitled "Skyrmions, Topology and Geometry", focused on analytical and numerical studies of localized lumps of energy in nuclear physics and Einstein's theory of gravitation.

Cookies will be provided before the talk at 4 p.m.
in the same room as the talk, Building 53 Room 206.