# Mathematics Colloquium

## Recent advances on extreme events to discrete and continuum models

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11:10 am – 12 p.m.
Building 180 Room 107

Abstract

In this talk, we will focus on the formation of rogue waves in the nonlinear Schrödinger (NLS) equation (and multi-component versions thereof) as well as the Salerno model containing the integrable Ablowitz-Ladik (AL) and (non-integrable) discrete NLS (DNLS) models. We will first consider Gaussian wavepacket initial data for both the NLS and Salerno models, where novel spatio-temporal dynamics will be presented as the Gaussian's width changes. We will show that large amplitude excitations strongly reminiscent of the Peregrine soliton, (time-periodic) Kuznetsov-Ma (KM) breather or regular solitons appear to form. Then, we will focus on the existence, stability and dynamics of discrete Kuznetsov-Ma breathers in the Salerno model. We will explore the configuration space of KM breathers by varying the period of the solution and the homotopy parameter associated with the Salerno model (connecting the AL and DNLS models). We will show that on one hand, the KM breather in the AL model is not the only one solution since more KM solutions bearing oscillatory tails are shown to be present therein. On the other hand, and as per the DNLS model, novel KM breathers will be presented in this case. The results will be complemented by a discussing the stability of the solutions using Floquet theory and numerical simulations. More recent results on the DNLS equation will be presented too (if time permits) and open problems and questions will be discussed.

*About the speaker*: Stathis Charalampidis' research focuses on studies of complex systems originating from problems in mathematical physics, condensed matter physics, nonlinear optics, materials science, and fluid mechanics. He has been developing analytical and computational techniques for studying the existence, stability and bifurcations as well as spatio-temporal evolution of nonlinear waves to nonlinear ODEs and PDEs. His research on materials science has been supported by an RSCA grant (2020-2022) he received with Prof. Simon Xing (Mechanical Engineering, Department at Cal Poly), and the work led to a joint manuscript with a Cal Poly undergraduate student (Marisa Lee) that was submitted for publication in the Physical Reviews E. Moreover, Professor Charalampidis was nominated as the "Emergent Leader in Optics" by the Institute of Physics (IOP) in the UK for his contributions in nonlinear optics. Recently, he was awarded a three-years research grant from NSF's Division of Mathematical Sciences in order to study collapse phenomena and extreme events/rogue waves in PDEs. Before joining Cal Poly in 2019, he was a Lecturer and Chief Undergraduate Advisor (2018-2019), Visiting Assistant Professor (2015-2018) and Postdoctoral Research Associate (2013-2015) at UMass Amherst. Stathis earned his PhD in Applied Mathematics from the Department of Mathematical, Physical and Computational Sciences at Aristotle University of Thessaloniki, Greece.