2025 Ulam Colloquium

Speaker: Professor Gui-Qiang G. Chen
University of Oxford

Introduced by Professor Kevin Knudson
Interim Associate Dean
College of Liberal Arts and Sciences, UF

Wednesday, January 15, 2025
3:00-3:50 PM, Little Hall 101
Refreshments at 2:30 pm in Little Hall 339

Partial Differential Equations of Mixed Type − Analysis and Applications

Three of the fundamental types of partial differential equations (PDEs) are elliptic, hyperbolic, and parabolic, following the standard classification for linear PDEs. Linear theories of PDEs of these types have been considerably better developed. On the other hand, many nonlinear PDEs arising in Mathematics and Science are naturally of mixed type. The solution to several longstanding fundamental problems greatly requires a deep understanding of such nonlinear PDEs of mixed type, particularly those of mixed elliptic-hyperbolic type. Notable examples include the multidimensional Riemann problem (formulated by Riemann in 1860 for the one-dimensional case) and related shock reflection/diffraction problems in fluid dynamics (the compressible Euler equations), and the isometric embedding problem in differential geometry (the Gauss-Codazzi-Ricci equations), among others. In this talk, we will present some old and new underlying connections of nonlinear PDEs of mixed type with these longstanding fundamental problems, from the Riemann problem to the isometric embedding problem. We will then discuss some recent developments in the analysis of these nonlinear PDEs through examples with an emphasis on developing unified approaches, ideas, and techniques for addressing mixed-type problems. Some further developments, perspectives, and open problems in this direction will also be addressed.

Professor Gui-Qiang G. Chen received his PhD from the Chinese Academy of Sciences in 1987. He was a faculty member at the University of Chicago and Northwestern University for twenty years before moving to the UK. He is now the Statutory Professor at the University of Oxford and Director of the Oxford Centre for Nonlinear Partial Differential Equations (OxPDE). In recognition of his significant contributions to nonlinear PDEs, he was awarded the Pólya Prize by the London Mathematical Society in 2024. His numerous other honors and awards include the Royal Society-Wolfson Research Merit Award, the Alfred P. Sloan Foundation Fellowship, and recognition as a Member of Academia Europaea, as well as a Fellow of both the American Mathematical Society (AMS) and the Society for Industrial and Applied Mathematics (SIAM).

Stanislaw Ulam (1909-1984) was a Graduate Research Professor at the University of Florida from 1974-1984, and was one of the 20th Century's leading mathematicians. In 1998-99, under the leadership of Chair Krishnaswami Alladi, the Department of Mathematics initiated the annual Ulam Colloquium Lecture Series in Applied Mathematics at the University of Florida.