Dr. Junping Shi

College of William & Mary
USA

Junping Shi is a Professor of Mathematics at the College of William & Mary in Williamsburg, Virginia, USA. He studied mathematics at Nankai University, China, from 1990 to 1993, and earned his Ph.D. in Mathematics from Brigham Young University in 1998. His research interests include nonlinear elliptic and parabolic equations, bifurcation theory, and mathematical biology. His research has been supported by the U.S. National Science Foundation (NSF) since 2003. He served as Chair of the Department of Mathematics at William & Mary from 2018 to 2022 and again in 2025, and was Director of the NSF EXTREEMS-QED program at William & Mary from 2013 to 2019. He has published more than 190 research papers, which have received over 11,000 citations according to Google Scholar.

Title: Bifurcation and Pattern formation in reaction-diffusion models with nonlocal advection and time delays

Abstract:
Reaction-diffusion equations with nonlocal advection and time delays arise naturally in ecological and biological systems where movement is influenced by spatially distributed information, such as perceived resource landscapes or memory of previously visited locations. These models incorporate cognitive or behavioral mechanisms by allowing individuals to respond to environmental signals averaged over spatial regions and past times. We review several classes of reaction–diffusion models in which advective movement is governed by spatiotemporal information of population distributions. Different types of advection potentials lead to distinct forms of nonlocal advective forces. When the nonlocal interaction is sufficiently attractive or repulsive, symmetry-breaking bifurcations occur, producing aggregation or segregation patterns, as well as time-periodic solutions that persist as asymptotic states.