Dr. Thomas Yizhao Hou

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Thomas Yizhao Hou is the Charles Lee Powell professor of applied and computational mathematics at Caltech.

His research interests include singularity of 3D Euler and Navier-Stokes equations, multiscale problems and data analysis. He received his Ph.D. from UCLA in 1987, became a postdoc at Courant institute in 1987 and joined the Courant Institute as a junior faculty member in 1989. He moved to Caltech in 1993 and was named the Charles Lee Powell Professor in 2004. Dr. Hou has received a number of honors and awards, including a member of American Academy of Arts and Sciences in 2011, a member of the inaugural class of SIAM Fellows in 2009 and AMS Fellows in 2012, the Computational and Applied Sciences Award from USACM in 2005, the Morningside Gold Medal in Applied Mathematics in 2004, the SIAM Wilkinson Prize in Numerical Analysis and Scientific Computing in 2001, the Frenkiel Award from the Division of Fluid Mechanics of APS in 1998, the Feng Kang Prize in Scientific Computing in 1997, a Sloan fellow from 1990 to 1992. He was also the founding Editor-in-Chief of the SIAM Journal on Multiscale Modeling and Simulation from 2002 to 2007.

Title: Stable and nearly self-similar blowup on the 3D Euler incompressible equations with smooth data

Abstract: Whether the 3D incompressible Euler equations can develop a finite time singularity from smooth initial data is one of the most challenging problems in nonlinear PDEs. In this talk, I will present a recent result with Dr. Jiajie Chen in which we prove finite time blowup of the 2D Boussinesq and 3D Euler equations with smooth initial data. There are several essential difficulties in establishing such blowup result. We overcome these difficulties by decomposing the solution operator into a leading order operator that enjoys sharp stability estimates plus a finite rank perturbation operator that can be estimated by using energy estimates and space-time numerical solutions with rigorous error control. This enables us to establish nonlinear stability of the approximate self-similar profile and prove stable nearly self-similar blowup of the 2D Boussinesq and 3D Euler equations with smooth initial data and boundary. This provides the first rigorous justification of the Hou-Luo blowup scenario.