NUS National University of Singapore | IMS Institute for Mathematical Sciences

DISTINGUISHED VISITOR LECTURE SERIES

Stanley Osher

University of California, Los Angeles, USA

Stanley Osher is Professor of Mathematics, Computer Science, Chemical Engineering and Electrical Engineering at UCLA. He is also an Associate Director of the NSF-funded Institute for Pure and Applied Mathematics at UCLA. Osher is a member of the National Academy of Sciences and Fellow of the American Academy of Arts and Sciences, SIAM and AMS. He was awarded the SIAM Pioneer Prize at the 2003 ICIAM conference and the Ralph E. Kleinman Prize in 2005. In 2014 he received the Carl Friedrich Gauss Prize from the International Mathematics Union-this is regarded as the highest prize in applied mathematics. In 2016 he received the William Benter Prize.

He gave a plenary address at the 2010 International Congress of Mathematicians, and the John von Neumann Lecture at the SIAM 2013 annual meeting. He is a Thomson-Reuters highly cited researcher — among the top 1% from 2002-2014 in both Mathematics and Computer Science.

Overcoming the Curse of Dimensionality for Hamilton-Jacobi equations with Applications to Control and Differential Games

Plenary Talk 1: 29 May 2017 (Monday), 9-10am, IMS Auditorium

It is well known that certain Hamilton-Jacobi partial differential equations (HJ PDE's) play an important role in analyzing control theory and differential games. The cost of standard numerical algorithms for HJ PDE's is exponential in the space dimension and time, with huge memory requirements. Here we propose and test methods for solving a large class of these problems without the use of grids or significant numerical approximation. We begin with the classical Hopf and Hopf-Lax formulas which enable us to solve state independent problems via variational methods originating in compressive sensing with remarkable results.

We can evaluate the solution in 10^{-4} to 10^{-8} seconds per evaluation on a laptop. The method is embarrassingly parallel and has low memory requirements. Recently, with a slightly more complicated, but still embarrassingly parallel method, we have extended this in great generality to state dependent HJ equations, apparently, with the help of parallel computers, overcoming the curse of dimensionality for these problems.

The term, "curse of dimensionality" was coined by Richard Bellman in 1957 when he did his classic work on dynamic optimization.

What mathematical algorithms can do for the real (and even fake) world

Plenary Talk 2: 30 May 2017 (Tuesday), 9-10am, IMS Auditorium

I will give a very personal overview of the evolution of mainstream applied mathematics from the early 60's onwards. This era started pre computer with mostly analytic techniques, followed by linear stability analysis for finite difference approximations, to shock waves, to image processing, to the motion of fronts and interfaces, to compressive sensing and the associated optimization challenges, to the use of sparsity in Schrodinger's equation and other PDE's, to overcoming the curse of dimensionality in parts of control theory and in solving the associated high dimensional Hamilton-Jacobi equations.

FREE ADMISSION