数学与系统科学研究院

计算数学所学术报告

报告人：Prof. Nicholas Zabaras

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报告题目：

Bayesian Deep Learning as a Paradigm for Uncertainty Quantification in Scientific Computing

邀请人：　　周涛副研究员

报告时间：2018 年3月12日（周一）

上午10:00--11:00

报告地点：数学院科技综合楼

Z311报告厅

报告摘要：

We are interested in the development of surrogate models for uncertainty quantification in problems governed by stochastic PDEs using a deep convolutional encoder-decoder network in a similar

fashion to approaches used in deep learning for image to image regression tasks. Since normal neural networks are data intensive and cannot provide predictive uncertainty, we propose a Bayesian approach to convolutional neural nets.

A recently introduced variational gradient descent algorithm based on Stein's method is scaled to deep convolutional networks to perform approximate Bayesian inference on millions of uncertain network parameters. This approach achieves state of the art performance in terms of predictive accuracy and uncertainty quantification in comparison to other approaches in Bayesian neural networks as well as techniques such as Gaussian processes and ensemble methods even when the training data size is relatively small. To evaluate the performance of this approach, we consider standard uncertainty quantification benchmark problems including flow in heterogeneous media defined in terms of limited data-driven permeability realizations. The performance of the surrogate model developed is surprisingly very good even though there is no underlying structure shared between the input (permeability) and output (flow/pressure) fields as is often the case in the image-to-image regression models used in computer vision problems. Uncertainty propagation tasks are considered and the predictive output Bayesian statistics are compared to those obtained with Monte Carlo estimates.

报告人简历：

Prof. Nicholas Zabaras joined Notre Dame in 2016 as the Viola D. Hank Professor of Computational Science and Engineering after serving as Uncertainty Quantification Chair and founding director of the "Warwick Centre for Predictive Modeling" at the University of Warwick.

His is a concurrent Professor of Applied and Computational Mathematics and Statistics, Civil and Environmental Engineering and Earth Sciences and Electrical Engineering. He was recently appointed Director of the interdisciplinary "Center for Informatics and

Computational Science (CICS)" that aims to bridge the areas of data-sciences, scientific computing and uncertainty quantification for complex multiscale/multiphysics problems in science and engineering. He is also serving as the Hans Fisher Senior Fellow with the Institute for Advanced Study at the Technical University of Munich where he was recently appointed "TUM Ambassador".

He was recently also appointed as an Honorary Professor at the Department of Mathematics at the University of Hong Kong. Prior to this, he spent 23 years serving in all academic ranks of the faculty at Cornell University where he was the director of the "Materials Process Design and Control Laboratory (MPDC)". He received his Ph.D. in Theoretical and Applied Mechanics from Cornell, after which he started his academic career at the faculty of the University of Minnesota.

Professor Zabaras' research focuses on the integration of computational mathematics, statistics, and scientific computing for the predictive modeling of complex systems. He has been honored with the Wolfson Research Merit Award from the Royal Society, theMichael Tien '72 Excellence in Teaching Prize from Cornell University, and the Presidential Young Investigator Award from the NationalScience Foundation. He is the founding Editor-in-Chief of the journal of IJUQ and he also acts as associate editor for many other international journals such as J. Comput. Phys.

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