Bridging Deep Neural Networks and Differential Equations for Image Restoration and Beyond

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Deep learning continues to dominate machine learning. It is now widely used in many research areas in science and engineering, and has major industrial impacts. Deep learning methods have achieved remarkable results in a variety of tasks, especially in a supervised learning environment. In this talk, I will start with a brief overview of classical (pre deep learning) image restoration methods. These models inspired some of our recent work on combining numerical differential equation and deep convolutional architecture design. We can interpret some of the state-of-the-art deep CNNs in terms of numerical (stochastic) differential equations; and propose new deep architectures that can further improve the prediction accuracy of the existing networks in image classification. We also show how to design transparent deep feed-forward convolutional networks to uncover hidden PDE models from observed dynamical data and to accurately predict the dynamical behavior.