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INTheory on-line Seminar Series 03

White-Box Deep (Convolution) Networks from the Principle of Rate Reduction

Speaker: Yi Ma

(EECS, UC Berkeley)

Host： Haiping Huang

Abstract：

In this talk, we offer an entirely "white box" interpretation of deep (convolution) networks from the perspective of data compression (and group invariance). In particular, we show how modern deep layered architectures, linear (convolution) operators and nonlinear activations, and even all parameters can be derived from the principle of *maximizing rate reduction* (with group invariance). All layers, operators, and parameters of the network are explicitly constructed via *forward propagation*, instead of learned via back propagation. All components of so-obtained network, called *ReduNet*, have precise optimization, geometric, and statistical interpretation. There are also several nice surprises from this principled approach: it reveals a fundamental tradeoff between invariance and sparsity for class separability; it reveals a fundamental connection between deep networks and Fourier transform for group invariance – the computational advantage in the spectral domain (why spiking neurons?); this approach also clarifies the mathematical role of forward propagation (optimization) and backward propagation (variation). In particular, the so-obtained ReduNet is amenable to fine-tuning via *both* forward and backward (stochastic) propagation, both for optimizing the same objective.

About speaker：

Yi Ma is a Professor at the Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley. His research interests include computer vision, high-dimensional data analysis, and intelligent systems. He received the NSF Career award in 2004 and the ONR Young Investigator award in 2005. He also received the David Marr prize in computer vision from ICCV 1999 and best paper awards from ECCV 2004 and ACCV 2009. He has served as the Program Chair for ICCV 2013 and the General Chair for ICCV 2015. He is a Fellow of IEEE, ACM, and SIAM.

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