

# Why Deep Learning Works So Well? What is Next?

**C.-C. Jay Kuo**

**University of Southern California**

Deep learning networks, including convolution and recurrent neural networks (CNN and RNN), provide a powerful tool for image, video and speech processing and understanding nowadays. However, their superior performance has not been well understood. In this talk, I will unveil the myth of the superior performance of CNNs. To begin with, I will describe network architectural evolution in three generations: first, the McCulloch and Pitts (M-P) neuron model and simple networks (1940-1980); second, the artificial neural network (ANN) (1980-2000); and, third, the modern CNN (2000-Present). The differences between these three generations will be clearly explained. Next, theoretical foundations of CNNs have been studied from the approximation, the optimization and the signal representation viewpoints, and I will present main results from the signal processing viewpoints and use an intuitive way to explain the complicated operations of the CNN systems. Although deep learning offers state-of-the-art performance in many application domains, it has several weaknesses. In the final part of my talk, I will point out several new research directions.

## Speaker's Biography



Dr. C.-C. Jay Kuo received his Ph.D. degree from the Massachusetts Institute of Technology in 1987. He is now with the University of Southern California (USC) as Director of the Media Communications Laboratory and Dean's Professor in Electrical Engineering-Systems. His research interests are in the areas of digital media processing, compression, communication and networking technologies. Dr. Kuo was the Editor-in-Chief for the IEEE Trans. on Information Forensics and Security in 2012-2014. He was the Editor-in-Chief for the Journal of Visual Communication and Image Representation in 1997-2011, and served as Editor for 10 other international journals. Dr. Kuo received the 1992 National Science Foundation Young Investigator (NYI) Award, the 1993 National Science Foundation Presidential Faculty Fellow (PFF) Award, the 2010 Electronic Imaging Scientist of the Year Award, the 2010-11 Fulbright-Nokia Distinguished Chair in Information and Communications Technologies, the 2011 Pan Wen-Yuan Outstanding Research Award, the 2014 USC Northrop Grumman Excellence in Teaching Award, the 2016 USC Associates Award for Excellence in Teaching, the 2016 IEEE Computer Society Taylor L. Booth Education Award, the 2016 IEEE Circuits and Systems Society John Choma Education Award, the 2016 IS&T Raymond C. Bowman Award, and the 2017 IEEE Leon K. Kirchmayer Graduate Teaching Award. Dr. Kuo is a Fellow of AAAS, IEEE and SPIE. He has guided 140 students to their Ph.D. degrees and supervised 25 postdoctoral research fellows. Dr. Kuo is a co-author of about 250 journal papers, 900 conference papers and 14 books.