Asymptotic Analysis of Higher-order Scattering Transform of Gaussian Processes

Gi-Ren Liu
Department of Mathematics
National Cheng Kung University

Abstract

In this talk, we will discuss the distribution distance between the output F of the scattering transform (ST) of a Gaussian process and its scaling limit G. ST is a nonlinear transformation that involves a sequential interlacing convolution and nonlinear operators, which is motivated to model the convolutional neural network. We will show that the total variation distance between the distributions of the output of ST and a chi-square random variable with one degree of freedom converges to zero at an exponential rate. For achieving this goal, we derive a recursive formula to represent the nonlinearity of ST by a linear combination of Wiener chaos and then apply the Malliavin calculus and Stein's method to estimate the maximal difference between the expectation values of $h(F)$ and $h(G)$ over a specific s et o f test functions h. This talk is based on joint work with Yuan-Chung Sheu (National Yang Ming Chiao Tung University, Taiwan) and Hau-Tieng Wu (Duke University, USA).