Better approximations of high dimensional smooth dunctions by deep neural networks with rectified power units

Author and Presenter: Haijun **Yu** (Academy of Math. & Systems Sci., CAS, China)

Co-authors: Bo **Li** (Academy of Math. & Systems Sci., CAS, China)
Shanshan **Tang** (Academy of Math. & Systems Sci., CAS, China)

Abstract

Deep neural networks with rectified linear units (ReLU) are recently getting very popular due to its universal representation power and easier to train. Some theoretical progresses on deep ReLU network approximation power for functions in Sobolev space and Korobov space have recently been made by several groups. In this talk, we show that deep networks with rectified power units (RePU) can give better approximations for smooth functions than deep ReLU networks. Our analyses base on classical polynomial approximation theory and some efficient algorithms we proposed to convert polynomials into deep RePU networks of optimal size without any approximation error. Our constructive proofs reveal clearly the relation between the depth of the RePU network and the order of polynomial approximation. Taking into account some other good properties of RePU networks, such as being high-order differentiable, we advocate the use of deep RePU networks for problems where the underlying high dimensional functions are smooth or derivatives are involved in the loss function.