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Mathematical Sciences BRL Seminar

Algorithm Unrolling for Massive Access via Deep Neural Networks With Theoretical Guarantee

Professor
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06/22(Wed) **14:00 - 15:00**
Venue Building 108, Room 319

Host
Prof. Bongsoo Jang bsjang@units.ac.kr

Abstract

Massive access is a critical design challenge of Internet of Things (IoT) networks. In this paper, we consider the grant-free uplink transmission of an IoT network with a multiple-antenna base station (BS) and a large number of single-antenna IoT devices. Taking into account the sporadic nature of IoT devices, we formulate the joint activity detection and channel estimation (JADCE) problem as a group-sparse matrix estimation problem. This problem can be solved by applying the existing compressed sensing techniques, which however either suffer from high computational complexities or lack of algorithm robustness. To this end, we propose a novel algorithm unrolling framework based on the deep neural network to simultaneously achieve low computational complexity and high robustness for solving the JADCE problem. Specifically, we map the original iterative shrinkage thresholding algorithm (ISTA) into an unrolled recurrent neural network (RNN), thereby improving the convergence rate and computational efficiency through end-to-end training. Moreover, the proposed algorithm unrolling approach inherits the structure and domain knowledge of the ISTA, thereby maintaining the algorithm robustness, which can handle non-Gaussian preamble sequence matrix in massive access. With rigorous theoretical analysis, we further simplify the unrolled network structure by reducing the redundant training parameters. Furthermore, we prove that the simplified unrolled deep neural network structures enjoy a linear convergence rate. Extensive simulations based on various preamble signatures show that the proposed unrolled networks outperform the existing methods in terms of the convergence rate, robustness and estimation accuracy.

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Mathematical Sciences Colloquium

Topological Data Analysis in Geometric Topology

Professor

Yang, Seoung Yeop

경북대 수학과

06/22(Wed) **15:00 - 16:00**

Venue Building 108, Room 319

Host

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Abstract

Data has shape and shape has meaning." Topological Data Analysis (TDA) is a recently emerging method for analyzing large-scale complex data using algebraic topology. The aim of TDA is to provide well-founded mathematical and algorithmic methods to analyze the complex geometric and topological structures underlying point cloud datasets. In this talk, we briefly introduce what TDA is and then discuss how it can be used in the study of geometric topology, especially knot theory.