学术报告会

时　间：4月10日（周三）10:00-11:00

地　点：电院群楼2-406

Graph Convolutional Neural Networks

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Abstract:

Convolutional neural networks (CNNs) have shown remarkable performance in a wide array of inference and reconstruction tasks. The objective of CNNs is to find a computationally feasible architecture capable of reproducing the behavior of a certain unknown function. One of the key for their success is that the structure of a CNN consist of a succession of layers, each of which performs simple operations which include a convolution, the application of a scalar nonlinearity, and the implementation of a pooling (downsampling) operator. Because the classical convolution and downsampling operations are defined for regular (grid-based) domains, CNNs have been applied to act on data modeled by such a regular structure, like time or images. However, an accurate description of modern datasets such as those in social and biological networks calls for more general irregular structures. Motivated by this, we describe several architectures that generalize convolutional neural networks (CNNs) for the processing of signals supported on graphs. The selection graph neural network (GNN) replaces linear time invariant filters with linear shift invariant graph filters to generate convolutional features and reinterprets pooling as a possibly nonlinear subsampling stage where nearby nodes pool their information in a set of preselected sample nodes. A key component of the architecture is to remember the position of sampled nodes to permit computation of convolutional features at deeper layers. The aggregation GNN diffuses the signal through the graph and stores the sequence of diffused components observed by a designated node. This procedure effectively aggregates all components into a stream of information having temporal structure to which the convolution and pooling stages of regular CNNs can be applied. A multinode version of aggregation GNNs is further introduced for operation in large scale graphs. An important property of selection and aggregation GNNs is that they reduce to conventional CNNs when particularized to time signals reinterpreted as graph signals in a circulant graph. Comparative numerical analyses are performed in a synthetic source localization application. Performance is evaluated for a text category classification problem using word proximity networks. Multinode aggregation GNNs are consistently the best performing GNN architecture.

Biography:

Antonio G. Marques received the telecommunications engineering degree and the Doctorate degree, both with highest honors, from the Carlos III University of Madrid, Spain, in 2002 and 2007, respectively. In 2007, he became a faculty of the Department of Signal Theory and Communications, King Juan Carlos University, Madrid, Spain, where he currently develops his research and teaching activities as an Associate Professor and serves as Deputy of the President for Strategic Policies. From 2005 to 2007 he was a visiting Ph.D. student at the University of Minnesota, Minneapolis, and, from 2008 to 2015, he held different visiting research and faculty positions there. In 2015, 2016 and 2017 he was a visitor scholar at the University of Pennsylvania, Philadelphia. His current research focuses on nonlinear and stochastic optimization of wireless and power networks, signal processing for graphs, and data science for networks, areas where he has written more than 100 journal and conference papers. Dr. Marques has served the IEEE in a number of posts (currently, he is an Associate Editor of the Signal Process. Letters, a member of the IEEE Signal Process. Theory and Methods Tech. Comm., a member of the IEEE Signal Process. Big Data Special Interest Group, the Technical Co-Chair of the 2019 IEEE CAMSAP Workshop, and the General Co-chair of the 2019 IEEE Data Science Workshop). His work has been awarded in several venues, with recent ones including IEEE SSP 2016, IEEE SAM 2016 and Asilomar 2015.