Learning Graphs From Nodal Observations Via Graph Filter Identification

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ABSTRACT:
The problem addressed in this talk is that of learning an unknown network from nodal observations, which are modeled as graph signals generated by linear diffusion dynamics that depend on the topology of the sought graph. We assume that the observed diffused signals can be modeled as the output of a linear graph filter, applied to a set of independent input graph signals with arbitrarily-correlated components. In this context, we first rely on observations of the output signals along with prior statistical information on the inputs to identify the diffusion filter. Critical to this end is the formulation of the problem as the solution of a system of quadratic equations. Then, we leverage that linear graph filters are polynomials of the so-called graph-shift operator (a matrix representation of the network topology) to recover the graph via a convex optimization problem. We address three cases of increasing complexity: undirected networks with white inputs, undirected networks with colored inputs, and directed networks with arbitrary inputs. The resultant problems can be recast as sparse recovery problem with either Boolean constraints (for the undirected case) or manifold constraints (for the directed case). Numerical tests corroborating the effectiveness of the proposed algorithms in recovering synthetic and real-world directed graphs are provided.

BIO:
Antonio G. Marques received the telecommunications engineering degree and the Doctorate degree, both with highest honors, from the Carlos III University of Madrid, Madrid, Spain, in 2002 and 2007, respectively. In 2007, he became a faculty in 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. From 2005 to 2015, he held different visiting positions at the University of Minnesota, Minneapolis, MN, USA. In 2015 and 2016, he was a Visitor Scholar in the University of Pennsylvania, Philadelphia, PA, USA. His research interests lie in the areas of signal processing, networking and communications. His current research focuses on stochastic optimization of wireless and power networks, signal processing for graphs, and nonlinear network optimization. He has served the IEEE in a number of posts, collaborating on the organization of more than 20 IEEE conferences and workshops. Currently, he is an Associate Editor of the SIGNAL PROCESSING LETTERS, a member of the IEEE Signal Processing Theory and Methods Technical Committee and a member of the IEEE Signal Processing for Big Data Special Interest Group. Dr. Marques’ work has been awarded in several conferences and workshops, with recent best paper awards including Asilomar 2015, IEEE SSP 2016 and IEEE SAM 2016.