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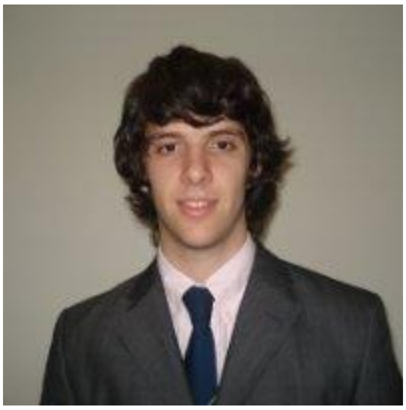
Graph Signal Processing: Applications



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Abstract:

Graph Signal Processing (GSP) generalizes classical tools developed for analyzing and processing time-varying signals to signals defined in more irregular graph domains. Graph signals, which are objects collecting the data associated with the nodes of a network, appear in many engineering and scientific fields, with examples including gene expression patterns defined on top of gene networks or the spread of epidemics over social networks. In this talk, we leverage basic GSP tools to study three relevant problems: sampling, graph-filter design, and network topology inference. We first look at the problem of sampling graph signals. While most works have focused on using the value of the signal observed at a subset of nodes to recover the signal in the entire graph, we will present a novel sampling scheme that uses as input observations taken at a single node and leads to distributed schemes for graph-signal reconstruction. We then move to the second problem and study the design of graph filters to implement arbitrary linear transformations between graph signals. We determine spectral conditions under which a specific linear transformation can be implemented perfectly using graph filters. Furthermore, for the cases where perfect implementation is infeasible, the design of optimal approximations for different error metrics is analyzed. The third and last application investigates how to leverage the information carried by graph signals to infer the (unknown) topology of the graph where those signals are defined. Our approach is to identify a topology that, while being consistent with spectral information encoded in the graph signals, it endows the network structure with certain desired properties such as sparsity. The focus is on developing efficient recovery algorithms along with the determination of recoverability conditions.

Biography:

Santiago Segarra received the B.Sc. degree in industrial engineering with highest honors from the Instituto Tecnológico de Buenos Aires (ITBA), Argentina, in 2011 and the M.Sc. degree in electrical engineering from the University of Pennsylvania, Philadelphia, in 2014. His research interests include network theory, data analysis, machine learning, and graph signal processing, areas where he has published more than 30 journal and conference papers. Mr. Segarra received ITBA’s 2011 award to the best undergraduate thesis in industrial engineering, the 2011 outstanding graduate award granted by the National Academy of Engineering of Argentina, and the Best Student Paper Award at the 2015 Asilomar Conference.