

Dr. Marcos Vasconcelos



OBSERVATION-DRIVEN SENSOR SCHEDULING

ABSTRACT

Modern large-scale distributed systems such as Cyber-physical systems and the Internet of Things often consist of components that communicate/interact over shared networks of limited bandwidth and operate with minimal delay. One way to model this constraint is to assume that, at any time instant, only a single packet can be reliably transmitted over the network to its destination. In order to coordinate access to this limited communication resource, it is common to use some form of medium access control (MAC) scheme. However, traditional MAC schemes, such as TDMA, FDMA, Aloha or CSMA, usually introduce undesirable delays and may not be well suited for systems with a large number of devices.

In this talk, I will discuss several results on optimal communication scheduling policies, the algorithms used to design them and their performance. A fundamental aspect of our results is that the scheduling decision is based on the observations at the sensors, rather than purely on their statistical description, which leads to the concept of "observation-driven scheduling". I will start with the design of a decentralized remote estimation system where multiple sensors observe distinct random variables and communicate their measurements to the destination over a collision channel. Using an approach based on team-decision theory, I will show that there is a globally optimal solution where each sensor uses a threshold policy.

Remarkably, this structural result is independent of the probability distribution of the random variables being estimated, which leads naturally to the application of data-driven approaches. Then, I will discuss the optimal design of a centralized collision avoidance policy by means of observation-driven scheduling, which is akin to the "dimensionality reduction" problem in Machine Learning. In this case, we obtain person-by-person optimal policies for the scheduling of sensors making Gaussian observations. Finally, I will show how our theoretical results can be applied to the data-driven design of scheduling policies where the joint probability density of the observations is unknown by using approximate subgradient methods to solve an empirical risk minimization problem.

BIOGRAPHY

Marcos Muller Vasconcelos is a postdoctoral research associate with the Department of Electrical Engineering at the University of Southern California. He received his PhD degree in Electrical Engineering from the University of Maryland, College Park in 2016. His current research interests include data-driven control and optimization, networked control and estimation, machine learning and systems biology.

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SEMINAR: 11:10 A.M. - 12:00 P.M.
*** VISION TALK: 12:00 P.M. - 12:30 P.M.**

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