



M21 – PARIS-SACLAY
03/06/2019-07/06/2019

**Multi-Agent Distributed Optimization and Learning
over Wireless Networks**



Luca Schenato

*Department of Informazion Engineering
University of Padova, Italy*

schenato@dei.unipd.it

<http://automatica.dei.unipd.it/people/schenato.html>



Ruggero Carli

*Department of Informazion Engineering
University of Padova, Italy*

carli@dei.unipd.it

<http://automatica.dei.unipd.it/people/carli.html>

Abstract of the course

Future large-scale control systems such as smart mobility systems, smart grids and Internet-of-Things will require the cooperation of a multitude of smart agents that will communicate locally via wireless. In this context, many control, estimation and identification engineering problems can be cast as multi-agent distributed optimization and learning problems. The major challenge in this context is the development of algorithms that are suitable for broadcast communication without the need of acknowledgment and for asynchronous updates. Specific emphasis is indeed placed in terms of lossy wireless communication. Another major challenge that will be addressed in this class is the analysis of time-varying systems which result in dynamic optimization and learning problems that are of paramount importance in time-critical control systems.

Covered topics:

- **Motivating examples:** parameter estimation, sensor calibration and map-building
- **The consensus algorithm:** standard, accelerated, push-sum/ratio, broadcast w/ lossy links
- **Non-expansive operators:** basic results and application to ADMM-based optimization
- **Distributed convex optimization:** Netwon-Raphson vs Gradient Descent vs ADMM
- **Distributed learning:** semiparametric Kernel-based solutions, Nystrom method
- **Space-time learning:** basic theory of Kernel-based regression, semi-parametric estimation with separable space-time Kernel
- **Partition-based/regional convex optimization and learning:** primal vs dual approaches