SEMINAR: "Distributed algorithms for Cyberphysical Systems"

Date: 23/06/2017 Speaker: Nick Freris (NYUAD)

Time: 12:00 Place: 21.42, ECE (old) Building, NTUA

Abstract

Cyberphysical Systems (CPS) are very large networks in which collaborating agents possessing sensing, communication and computation capabilities are interconnected for controlling physical entities. Applications are ubiquitous in sensor networks, robotics, transportation, and smart grids.

In this talk, I will present an overview of distributed, asynchronous, real-time algorithms for CPS, and illustrate applications in transportation and robotics. In specific:

a) Distributed synchronization and localization: We devise a randomized iterative algorithm for solving linear systems, establish exponential convergence and outline distributed implementation. We leverage our analysis to propose novel gossip algorithms for network-wide clock synchronization and GPS-free multi-agent localization.

b) Distributed optimization: We propose a new block-coordinate operator splitting method that can handle a wide range of problems in multi-agent systems, signal processing and machine learning. We establish exponential convergence under a certain metric subregularity condition (weaker than strong convexity). We proceed to develop randomized distributed methods for multi-agent optimization, and exhibit our methods in the context of Network Utility Maximization and Distributed Model Predictive Control.

c) Travel time estimation in transportation networks: We propose and analyze a method for performing compressed sensing on an infinite data stream. Our protocol involves a) encoding, via compressively sampling sliding windows of the data stream, and b) decoding, by means of solving LASSO using a newly developed quasi-Newton proximal method with accelerated convergence properties. We apply our framework to the problem of sparse kernel density estimation, and delineate its advantages for learning travel time distributions in the real-time.

Keywords:
Cyberphysical systems, Big data, Distributed optimization,
Clock synchronization, Localization, Compressed Sensing

Research areas:
Optimization, Control, Signal Processing, Machine Learning Applications,
Transportation, Robotics, Sensor Networks

Bio

Nick Freris is an assistant professor of Electrical and Computer Engineering at New York University Abu Dhabi (NYUAD), and a Global Network Assistant Professor at New York University Tandon School of Engineering. He is the director of Cyberphysical Systems Laboratory (CPSLab) at NYUAD, and a member of the Center for Cyber Security (CCS).

He received the Diploma in Electrical and Computer Engineering from the National Technical University of Athens (NTUA), Greece in 2005, and the M.S. degree in Electrical and Computer Engineering, the M.S. degree in Mathematics, and the Ph.D. degree in Electrical and Computer Engineering all from the University of Illinois at Urbana-Champaign in 2007, 2008, and 2010, respectively.

Dr. Freris's research interests lie in the area of cyberphysical systems: distributed estimation, optimization and control, data mining/machine learning, cyber security, and applications in transportation, sensor networks and robotics. His research was recognized with the 2014 IBM High Value Patent award, two IBM invention achievement awards, and the Gerondelis foundation award. Previously, Dr. Freris was a senior researcher in the School of Computer and Communication Sciences at École Polytechnique Fédérale de Lausanne (EPFL), Switzerland, from 2012-2014, and a postdoctoral researcher in IBM Research – Zurich, Switzerland, from 2010-2012.

Dr. Freris is a senior member of IEEE, and a member of SIAM and ACM.