Title: *Efficient code design for finite-blocklength coordination*
Related topics: Information Theory, Coding, Large deviations and Neyman-Pearson theory

Director: Laurent Clavier, IMT Lille Douai, CERI Systèmes Numériques
Supervisors:
Giulia Cervia, IMT Lille Douai, CERI Systèmes Numériques
Anne Savard, IMT Lille Douai, CERI Systèmes Numériques

Location: Lille (approximately 1h30 away from Paris by TGV, 1h30 away from London by Eurostar, and 30 minutes from Bruxelles)

Summary:

Ensuring cooperation of autonomous devices in a decentralized network is an ambitious objective that compels us to go beyond the traditional problem of reliable communications. We propose to use the notion of coordination, which is intended as a way of enforcing a prescribed joint behavior of the devices through communication, by synthesizing joint distributions which approximate a target behavior of the agents. With this project, we intend to move one step closer to real-life applications by looking at the short block-length regime. Moreover, this PhD thesis will tackle two complementary aspects of coordination with short packets. First, we will have to design efficient coding schemes which are consistent with the known capacity bounds for the coordination region in the short block-length setting. At the same time, given the lack of results on finite-length coordination, we aim at better understanding the nature of the coordination problem by deriving new bounds for multi-user network settings.

Objectives:

Within this PhD, we intent to focus on the following objectives:
Objective 1: Design of coordination coding schemes
Objective 2: Derivation of new coordination rate regions for multi-nodes networks

Additional information:

The successful candidate will be a member of the Digital System group of IMT Lille Douai (website: http://imt-lille-douai.fr/en/about-us/identity/). IMT Lille Douai is located in Villeneuve d'Ascq, at approximately 1h30 by TGV train from center Paris.

The successful candidate can start as early as September 2021.

Applications are sought from France, EU and international candidates with an outstanding academic background, especially in information theory, channel coding or related disciplines. Demonstrable mathematical skills will be essential. The candidate should be familiar with key engineering programming languages (Matlab, Python, …)
Applicants must have an Msc degree (M2, engineer degree or equivalent in France). A good and working knowledge of the English Language is required.

How to apply:

Interested candidates have to send their detailed CV, academic records (from Bsc to Msc level), at least two academic referees and a short motivation letter via email to the contacts below. Applications will be received until the 28th of May 2021.

Contacts:

Giulia Cervia
Email: giulia.cervia@imt-lille-douai.fr
Webpage: https://sites.google.com/view/giuliacervia/home-page

Anne Savard
Email: anne.savard@imt-lille-douai.fr
Webpage: https://pro.univ-lille.fr/anne-savard/

References:

- P. Cuff, H. H. Permuter, and T. M. Cover, Coordination Capacity, IEEE Transactions on Information Theory, 2010
- Y. Polyanskiy, H. V. Poor, and S. Verdu, Channel coding rate in the finite blocklength regime, IEEE Transactions on Information Theory, 2010
- G. Cervia, T. Oechtering and M. Skoglund, (ε,n) Fixed-Length Strong Coordination Capacity, *submitted to* IEEE Transactions on Information Theory, 2021
- G. Cervia, L. Luzzi, M. Le Treust and M. R. Bloch, Strong coordination of signals and actions over noisy channels with two-sided state information, IEEE Transactions on Information Theory, 2020
- M. R. Bloch, L. Luzzi, and J. Kliewer, Strong coordination with polar codes, IEEE Allerton 2012
- A. Savard, C. Weidmann, Optimized codes for the binary coded side-information problem, IEEE ISTC, Bremen, Germany, Aug. 2014
- A. Savard , L. Clavier, On the two-way diamond relay channel with lattice-based Compress-and-Forward, IEEE WCNC, Barcelona, Spain, April 2018