PhD Proposal

Modeling and Control of Social Dynamics in Static and Dynamic Networks

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Team: NeCS (http://necs.inrialpes.fr)
Duration: 3 years
Salary: full salary (≈ 1500 euros per month after taxes) + insurances, conditional to positive admission into the doctoral school

Key dates:
- For full consideration, contact the potential supervisors as soon as possible and no later than **May 30**.
- End of June: Selection completed.
- October 2018: PhD studies begin.

Context: This work will be carried out in the NeCS team (Networked Control Systems), a joint CNRS/INRIA team at GIPSA-Lab laboratory in Grenoble, France. The team's research concerns modeling, estimation and control of networked systems, with a broad spectrum of theoretical and applied topics including security and privacy in cyber-physical systems, traffic networks, intelligent vehicles, social dynamics, analysis of large-scale complex networks.

Candidate profile: The candidate will have a MS degree in Applied Mathematics, Control Systems, Electrical Engineering, or related disciplines.

Topic description: Recent developments in digital communication and social networking provide people with unprecedented possibilities to interact and consequently change their opinions and feelings. On social media platforms, individuals can be influenced either through advertising or through more subtle means like altering the way they interact. An early but still remarkable example of the latter possibility was the controversial Facebook experiment illustrated in [KGH14], which induced an emotional contagion in thousands of unaware users by tweaking their News Feeds to emphasize displays of sadness. The current situation motivates some urgent questions: How do opinions evolve in society dominated by digital interactions? To which extent can organizations or individuals orient public opinion and collective feelings? Supported by an established literature [Jac10], we will regard social systems as networks of interacting individuals: each individual possesses his/her opinion and interactions induce changes in the opinions. Mathematically, the structure of the social network is described by a graph: its nodes are the individuals and its arcs represent relations of friendship or acquaintance, which allow for the interactions. While on a short time scale the social network can sometimes be assumed to be fixed, on a longer time scale it is bound to change due to the addition or removal of both nodes and arcs [HM17]. The project will start from models of social dynamics proposed by social scientists and will investigate their system-theoretic properties, aiming to identify both fundamental limitations and feasible control strategies. As an example of possible strategy, [RF18] seeks effective algorithms optimize the position of opinion leaders in the social network.

Bibliography:

[HM17] J.M. Hendrickx and S. Martin. Open multi-agent systems: Gossiping with random arrivals and departures. ArXiv:1709.05142, 2017.
[KGH14] A. D. I. Kramer et al. Experimental evidence of massive-scale emotional contagion through social networks. PNAS, 111(24):8788–8790, 2014
[Jac10] M. O. Jackson. Social and economic networks. Princeton University Press, 2010.
[RF18] Wilbert Samuel Rossi and Paolo Frasca. On the convergence of message-passing computation of harmonic influence in social networks. IEEE Transactions on Network Science and Engineering, January 2018