Dynamic competitive opinion control: theory, simulations, and experiments

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Opinion control, i.e., the study of strategically influencing agents on social networks with the aim to align their opinions, behaviours, or choices with certain targets, has been extensively studied in competitive and non-competitive scenarios, mostly via variants of models based on the seminal independent cascade model [1]. However, these models may not be appropriate in situations in which agents are subject to various sources of social influence, and decisions can be changed over time. The voter model, by allowing agents to repeatedly change their opinion, provides a more accurate description of the underlying opinion dynamics mechanism, but, although recent work has started to address the problem of opinion control in the voter model [2], to the best of our knowledge these studies focussed on static control and have rarely addressed competition among multiple parties.

In this presentation we discuss our most recent results, as well as illustrate ongoing research, on dynamic and competitive opinion control. Our approach brings together theoretical results, agent-based simulations, and experimental work with the goal of gaining a more comprehensive understanding of this topic.

In our simulations and theoretical work, we consider the case of a strategic influencer (SI) who is competing with one opponent, and we focus on the dependency of optimal strategies on time horizons and network degree heterogeneity. Our results suggest that that low-degree nodes represent better control targets when the time horizon is short, whereas hubs are ideal targets for long time horizons. Moreover, our results suggest that optimal strategies vary depending on the initial state of the network. Importantly, we find that, when many nodes are aligned with the SI's opinion, its best strategy is to neutralise its opponent's influence. Conversely, when most voters hold a different opinion than that of the SI, the best strategy is to directly target opposing low-degree nodes and avoid the opponent's influence. We also find that network heterogeneity plays an important role in finding the SI's best response to its opponent. In particular, we find that optimal control strategies vary markedly depending on in-degree heterogeneity with optimal control being the more focused on out-degree hubs the less in-degree heterogeneous the network. Moreover, by analysing the dependence of the resulting equilibria on resource endowments of the competing influencing parties, we show that resource-poor opponents gain a disproportionate advantage by exploiting out-degree heterogeneity, whilst resource-richer opponents prefer homogeneous network architectures.

For our experimental work, we build an opinion control game in which human subjects play either against other human subjects or against intelligent agents. The goals of this experiment are twofold: first, we aim at understanding people's decision-making process in a dynamic opinion control scenario. Second, we intend to find dominant strategies that emerge when the participants are connected through a social network and play against their neighbours. In this presentation, we will discuss preliminary results, as well as outline future research directions and challenges that can be addressed with this approach.

[1] D. Kempe et al., "Maximizing the spread of influence through a social network.", Proceedings of the 9th International Conference on Knowledge discovery and Data Mining (KDD), Washington, DC, USA (2003).
[2] N. Masuda, "Opinion control in complex networks", New Journal of Physics 17, 033031 (2015).