Master Thesis proposal
Controllability of complex networks

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This proposal is for a Master thesis in in the field of **Control Theory.**

In recent years, there has been a lot of research into the problem of controlling large-scale complex networks. One interesting approach is proposed in [2] where a purely graphical controllability concept is used [1], particularly suitable for poorly known systems. It consists in studying the following linear time-invariant system

$$\dot{x} = Ax + Bu,$$

in which only the positions of the zero entries of A and B are fixed, while the nonzero entries could be any (nonzero) number. Controllability is guaranteed generically, i.e., for almost all choices of these nonzero entries [1]. Following [2], if only the topology of a network is given (i.e., A), how do we select a *minimal set of control inputs* (i.e., B) so as to guarantee that by acting on these inputs we can reach all the nodes of the network?

If instead the matrices A and B are known exactly, then a number of classical methods can be adapted from Control Theory. For example in [3], the PHB test is used.

The objective of this thesis is to investigate various approaches to the controllability of large-scale complex networks, and to develop efficient computational methods applicable to existing real-world networks.

References

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[3] Z. Yuan, C. Zhao, Z. Di, W.-X. Wang, and Y.-C. Lai. Exact controllability of complex networks. *Nat Commun*, 4, 09 2013.