Cartesian and Kronecker Products

We investigate the Cartesian and Kronecker product of a graph and demonstrate both to be special graph products that decomposes both the network topology and network dynamics. Moreover, we are able to perform this task efficiently. We employ this decomposition to present large semi-autonomous networks as smaller factor semi-autonomous networks. New tools for network trajectory factorization, controllability and observability follow from the Cartesian and Kronecker product factorization.

socialCartesianProductFull.png

Publications:

- Airlie Chapman, Marzieh Nabi-Abdolyousefi and Mehran Mesbahi (2014) "Controllability and Observability of Network-of-Networks via Cartesian Products". In IEEE Transactions on Automatic Control. (to appear)
- Airlie Chapman and Mehran Mesbahi (2014) Kronecker Product of Networked Systems and their Approximates, 1426-1431. In 21st International Symposium on Mathematical Theory of Networks and Systems. Slides
- Airlie Chapman, Marzieh Nabi-Abdolyousefi and Mehran Mesbahi (2012) Controllability and Observability of Cartesian Product Networks, 80-85. In Proc. of the IEEE Conference on Decision and Control. (Invited Paper) Slides

Structural Controllability

Structural controllability establishes generic (weak) and complete (strong) controllability of a network based solely on the direct coupling between nodes. This is irrespective of the magnitude of these couplings. We provide necessary and sufficient conditions for strong structural controllability involving constrained matchings over the upartite graph representation of the network.

conceptImageSControllability.png

Publications:

- Airlie Chapman and Mehran Mesbahi (2013) "Security and Infiltration of Networks: A Structural Controllability and Observability Perspective". In Springer's Lecture Notes on Control and Information Sciences. (to appear)
- Airlie Chapman and Mehran Mesbahi (2013) On Strong Structural Controllability of Networked Systems: A Constrained Matching Approach, 6141-6146. In Proc. of the American Control Conference. Slides