Model reduction of network systems with structure preservation

Cheng, Xiaodong

Propositions
belonging to the thesis entitled

Model Reduction of Network Systems with Structure Preservation

by

Xiaodong Cheng

1. In most cases, complex models of systems are neither practical nor necessary for analysis, simulation, and controller design, etc. Thus, there is usually a need for model reduction, which allows us to capture the essential aspects of the mechanisms underlying the systems interactions without a significant loss of accuracy. (This thesis)

2. As transfer functions characterize the input-output behaviors of linear systems, the $\mathcal{H}_2$ norms are useful metrics to measure the dissimilarities of linear nodal dynamics, which are fundamental for clustering-based model reduction of dynamical networks. (Part I)

3. For semistable systems, the standard Gramian matrices are no longer well-defined, and thus they cannot be applied to compute the relevant $\mathcal{H}_2$ norms. Instead, we can adopt the pseudo Gramians to characterize the $\mathcal{H}_2$ norms. (Chapter 3)

4. In the case of clustering-based reduction of dynamical directed network models, the concept of vertex clusterability is useful to guarantee the boundedness of the approximation error. (Chapter 6)

5. Compared with the standard Gramian matrices, the generalized ones give us more freedom to choose a reduced-order model such that some structures of interest may be preserved. However, the price is that we potentially obtain a larger error bound. (Chapter 7 & 8)

6. Every time we make progress in science and technology, it is because of an improvement in our ability to understand and control nature.

7. *In mathematics the art of proposing a question must be held of higher value than solving it.* (Georg Cantor, a German mathematician)
This is one of the most important things that I have learned in my four years of research.