

A Rank-Minimization Approach to Learning Dynamical Systems from Frequency Response Data

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In this talk, we present a data-driven method to learn linear dynamical systems from frequency response data. The dynamics of a linear time-invariant system can be completely characterized in terms of frequency response data. There exist several engineering techniques to measure frequency response data. Furthermore, using prior engineering knowledge, one usually gets a good idea of the structure of the linear system, that is, whether the system is a mechanical (dissipative) system, and/or a delay system, and so on. Consequently, we enforce the assumed structure while learning a linear dynamical system from the frequency response data. In this talk, we discuss a novel approach to learn linear structured dynamical systems. For this, we present a connection between a rank-minimization problem and learning low-dimensional structured dynamical systems.

However, solving rank-minimization problems is, in general, known to be NP-hard. As a remedy, we discuss relaxations obtained by replacing the rank constraint by appropriate non-smooth functions of singular values. Even after relaxing, the resulting optimization problem is non-smooth non-convex. But we show that the solution of the optimization problem can be given by a simple iterative algorithm based on singular value thresholding. We illustrate the efficiency of the proposed methodology by means of practical examples.