Parameter estimation of system of ODEs using Dynamic Mode Decomposition

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Any unsupervised Machine learning algorithm makes implicit assumptions about the underlying structure of the system being studied. These assumptions are transferred from experience and knowledge of the users (domain experts, analysts, ...) regarding underlying mechanisms governing the behavior of a system. In many time-series collected from process industry or similar domains where there are large time-constants involved in the behavior of the system dynamic of the system can be assumed to follow a system of ordinary differential equations. Using data-driven approaches one can attempt to find the parameters defining these equations.

A tool that has been extensively used for identifying the dynamics of an unknown system by finding the governing modes in it is Dynamic Mode Decomposition (DMD). It has been applied in many physical systems as well financial and biological systems. The goal of this thesis is to use DMD to estimate the parameters of the underlying system of ODEs and study the evolution of these parameters to identify the instances the system transitions from one operation state to another one.

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