Numerical Test Rig for Large-Scale and Interconnected Dynamical Systems

submitted
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Abstract

The goal of this project was to develop a test rig for large-scale and interconnected dynamical systems. The result is MTIDS or Matlab Toolbox for Interconnected Dynamical Systems, which is a mash-up that wraps different toolboxes used for graph analysis and dynamic systems simulation together. MTIDS allows the definition and analysis of graphs, where each node has a specific dynamic assign to it. The template based design of nodes' dynamics allows great flexibility for the creation of complex interconnected dynamical systems with the possibility of implementing clusters/layers. MTIDS is an open-source project under the GNU GPL v2 license. This document presents a general desciption of MTIDS and intructions for its use.

Contents

Chapter 1

Introduction

In this first Chapter the motivation behind the MTIDS project is explained and the project's goal and framework is presented.

1.1 Motivaion

Large-scale interconnected dynamical system are everywhere: biological systems, power and water systems, the brain neurons, social interaction networks, economic markets, etc. In a cononical form all of this systems can be thought as a bunch of nodes with local dynamics that interact with each other, e.g. a graph. Different topologies of the graph, may lead to different behavior. An example of various large scale interconnected systems can be seen in Figure 1.1.

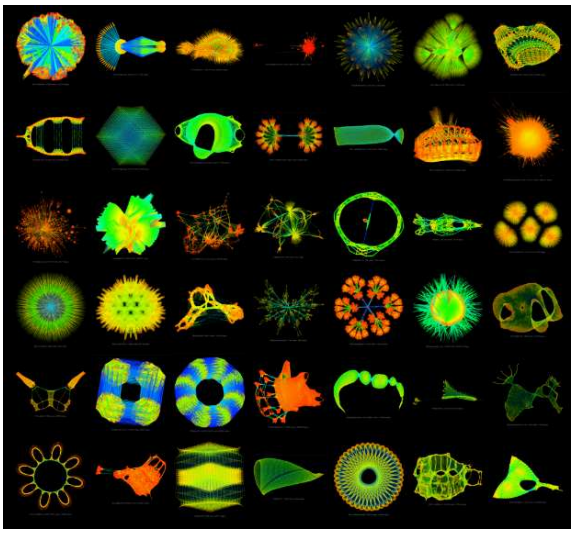

Figure 1.1: Visualization of various large scale systems using the sfdp algorithm © Dr. Yifan Hu of AT&T Labs

There are many tools available for the analysis of interconnected dynamical systems,

for example in power systems you have PSSE and Power Factory. However, this simulation programs are normally very system specific and in most cases it takes a long time to learn how to use them correctly. The difficulties are specially noticed while testing control concepts, where small changes on the topology of the grid or control concept could lead to a painful redesign of your simulation set up. You may actually end up spending the most of your time in the implementation of a simulation. A more general and easy to use solution for the simulation of interconnected dynamical systems is needed.

1.2 Idea and Goal

MTIDS (Matlab Toolbox for Interconnected Dynamical Systems) is a project that aims to design an easy to use and flexible toolbox to make the simulation of large scale dynamical systems easier for students and researchers. The **goal** is to produce a mash-up that wraps different toolboxes used for graph analysis and dynamic systems simulation together into a framework.

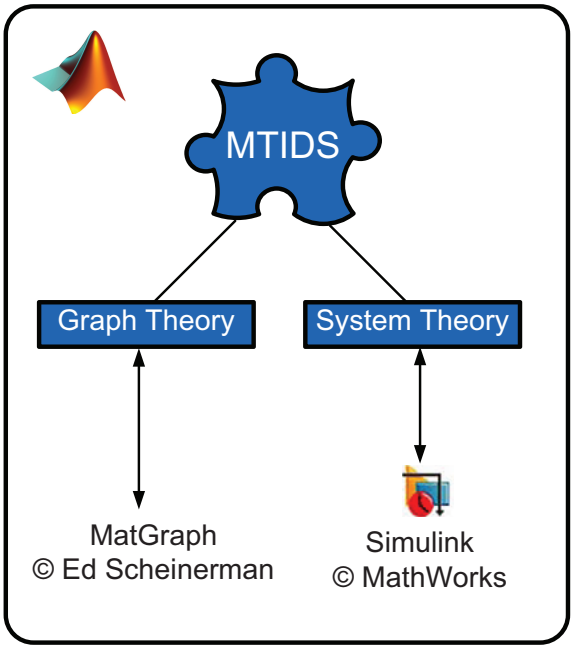

Figure 1.2: MTIDS: Matlab Toolbox for Interconnected Dynamical Systems

As we can see in Figure 1.2 MTIDS runs in the MATLAB enviroment and is basically a GUI that allows the interaction of tools used in graph theory and control theory. For graph theory we use Matgraph a toolbox design by Prof. Scheinerman of the John Hopkins University and for dynamical simulations we use Simulink.

1.3 Framework

The current framework of MTID is made out of three basic composnents. A GUI (**mtids.m**) an export to simulink function (**exportSimulink.m**) and an inport from Simulink function (**importSimulink.m**).

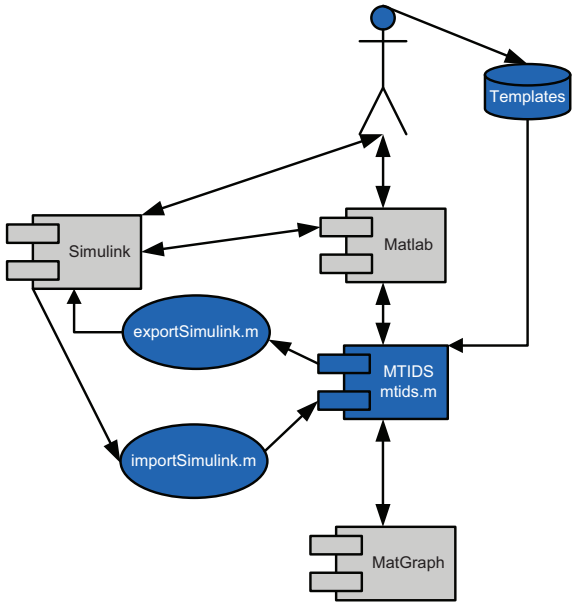

Figure 1.3: MTIDS: Components diagram

In Figure 1.3 we can see that the most important component is the user, specially its head. The better you are at producing templates and interacting with matlab and simulink the more functional MTIDS is going to be for you. In a nutshell MTIDS works as fallows:

- GUI (mtids.m) runs inside Matlab
- GUI interacts with Matgraph: create, modify and visualize graphs
- System Inteconnector (SI): exportSimulink.m and importSimulink.m called from GUI to interact with Simulink
- Templates done by User in Matlab/Simulink.
- Simulations done in Simulink

Chapter 2

Graphic Theory

Chapter 3

System Theory

Chapter 4

Conclusion and Future Development

4.1 Conclusion

4.2 Future Development

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