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Simulation of networked control system based on fuzzy controller

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ABSTRACT

The networked control system has been a hotspot in the research fields of control theory and control engineering applications. His advent that he uses less cable, easy to extend and has great flexibility, resource sharing and remote controlling, etc. In this poster a fuzzy control action networked has been proposed, which is based on TrueTime applied to a level control of nonlinear coupled tank system. The simulation results obtained using TrueTime toolbox in Matlab are presented in order to analyze the system in real time.

Keywords—Fuzzy controlleur, Networked control system, TrueTime, Couple tank.

1. INTRODUCTION

Control systems have evolved considerably thanks to the vast progress made in network technology in recent decades, where point-to-point cables are replaced by communication networks[1][2]. The control system consists of a non-linear coupled tank system controlled via a wired network by a remote station. The objective is to present the design of the system control so that it can achieve the desired setpoint. For this purpose, fuzzy controller is implemented.

2. Couple - Tank System & Controller

1-Couple-Tank System

The system has been illustrated in **Fig.1**

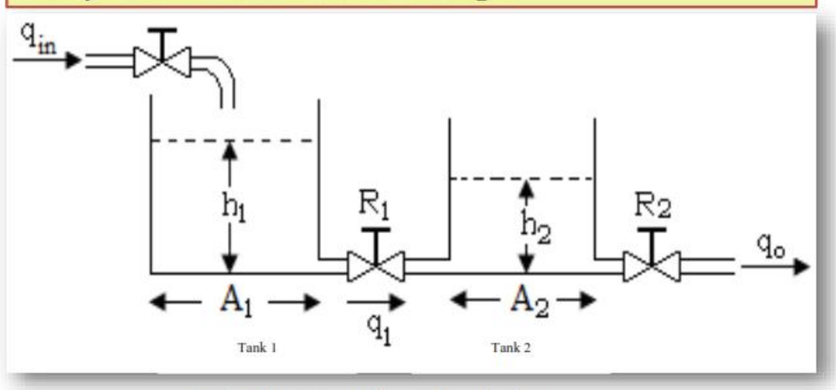


***Fig.1**: Couple –Tank System*

The objective of the system will be to regulate the height of the level in tank number 2 using the flow rate of pump number 1. We will therefore have the flow rate q_{in} at the inlet and the height in tank number 2 (h_2) at the outlet.

Model equation

The transfer function is given by [3]:

$$\frac{H_2(p)}{Q_{in}(p)} = \frac{R_2}{A_1A_2R_1R_2p^2 + (A_1R_1 + A_2A_2 + R_2A_1)p + 1}$$

The system characteristics are given in the table :

***Table.1**: Numerical data of the system [3]*

Parameter	Value
A_1	66.4424 cm^2
A_2	66.4424cm^2
R_1	1.05 cm^2/s
R_2	1.5225 cm^2/s

2- Fuzzy Logic Controller

We have defined two inputs **E**, **dE** and one output **U** for the fuzzy logic controller.

The fuzzy controller was developed by the following 3steps:

- **Fuzzification**
- **The rules table**
- **Defuzzification**

***Table.2:** The rules table*

E / dE	NL	NM	NS	Z	PS	PM	PL
NL	NL	NL	NL	NL	NM	NS	Z
NM	NL	NL	NL	NM	NS	Z	PS
NS	NL	NL	NM	NS	Z	PS	PM
Z	NL	NM	NS	Z	PS	PM	PL
PS	NM	NS	Z	PS	PM	PL	PL
PM	NS	Z	PS	PM	PL	PL	PL
PL	Z	PS	PM	PL	PL	PL	PL

3. Architecture of networked control system

The networked Control Systems (NCS) are controller systems, diagnostic systems, actuators, sensors and other applications that communicate via a communication network **Fig.2** [4] .

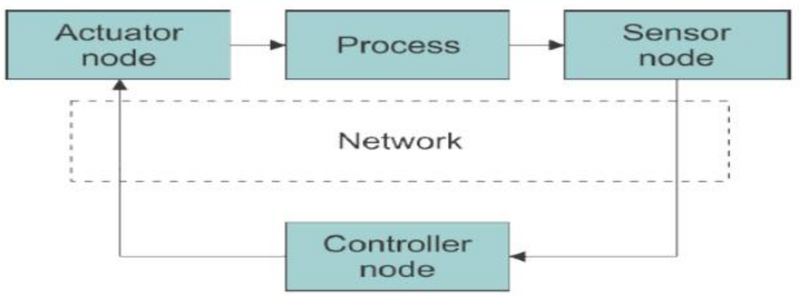


***Fig.2**: Networked Control System*

4. TrueTime

TrueTime is a Matlab/Simulink-based simulator for networked and embedded control systems. This toolbox facilitates co-simulation of controller task execution in real-time kernels, network transmissions and continuous plant dynamics. The simulator software consists of a Simulink block library **Fig. 3** and a collection of MEX files [5].

TrueTime Bloc

Every TrueTime toolbox simulation scheme should contain three crucial parts :

TrueTime kernel, **TrueTime network** (network model) and a **controlled process**.

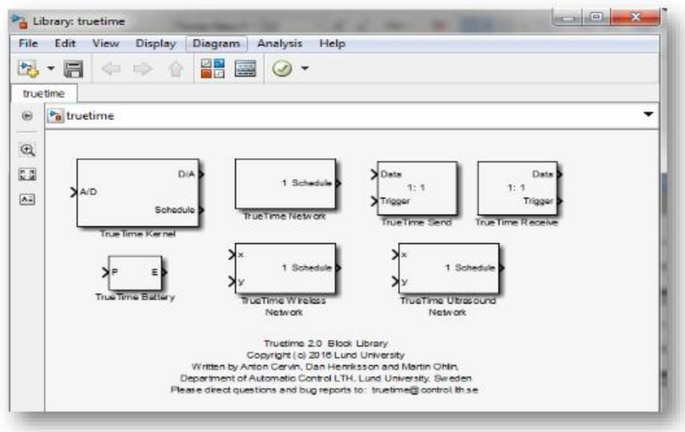
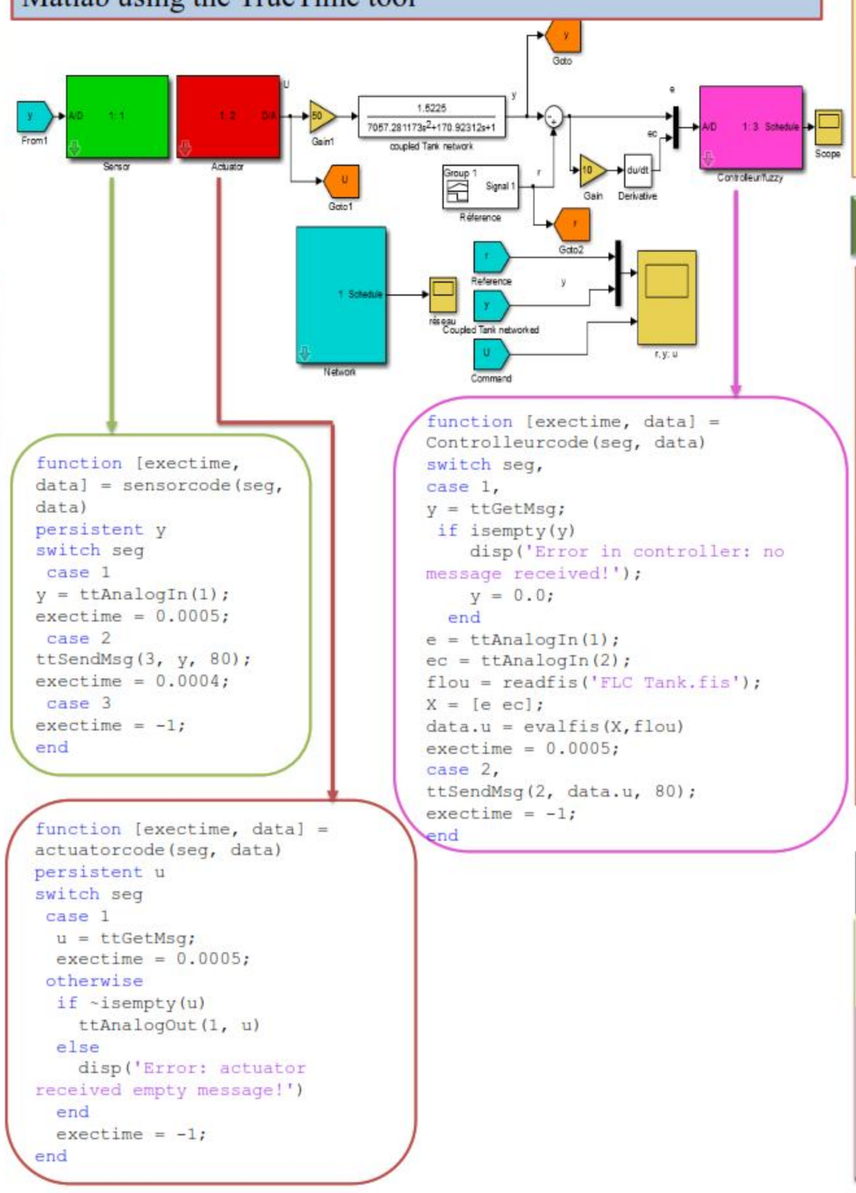


***Fig.3:** TrueTime Bloc Library*

Our network control system was modeled via Simulink and Matlab using the TrueTime tool



5.Simulation and Results

Simulation of the coupled tank response by the Fuzzy controller is as follows:

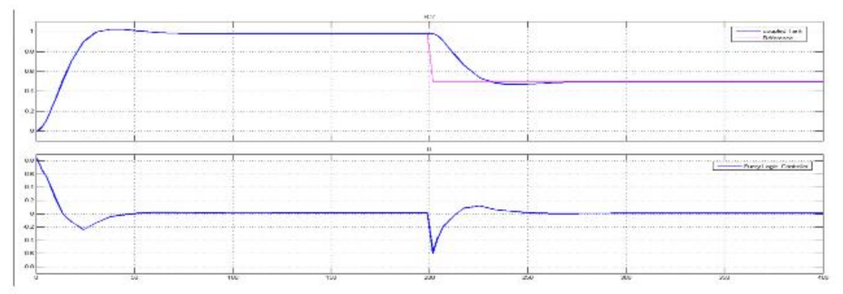


***Fig.4**: Simulation of the coupled tank response*

Simulation of the coupled tank response by the Fuzzy controller with TrueTime and the Network response are shown in **Fig.5, Fig.6**

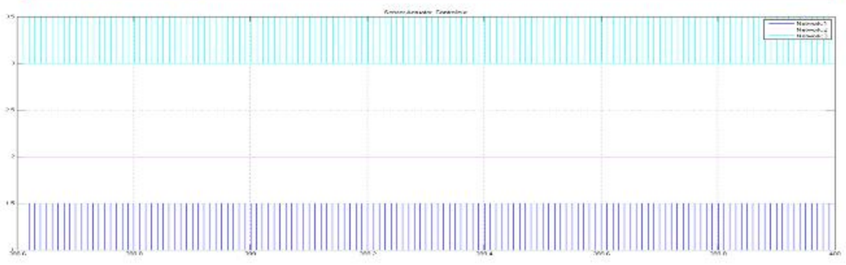


***Fig.5**: Simulation of the Network response*

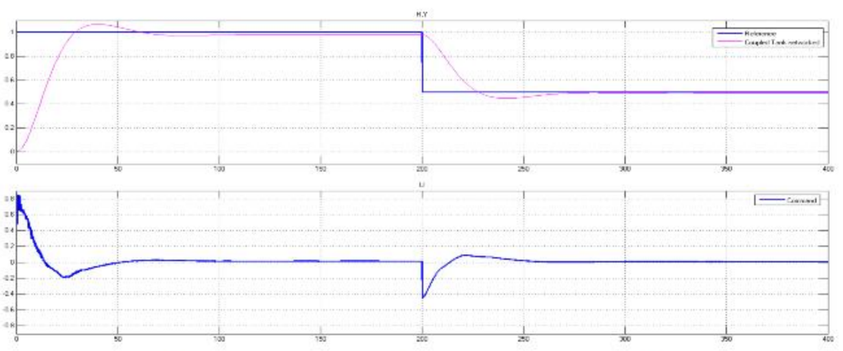


***Fig.6**: Simulation of the coupled tank response with TrueTime*

6. Conclusion

TrueTime Toolbox is a simple but powerful network simulation tool that can effectively simulate real-time network control systems. It is a highly customizable system with a rich set of network types and parameters.

In this work, fuzzy control networked has been proposed, based on TrueTime.Analysis of the output results of networked modelled systems can improve the quality and stability of closed-loop control systems in real time and avoid problems in practical applications.

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