SIDaC'19

Under the auspices of Prof. DIBI Zohir
Rector of the University Larbi Ben M'hidi
Oum El Bouaghi, Algeria.

Design of a Fuzzy Supervisor For a Nonlinear System

Bennour Hachem [1], Bayarassou Houria[1] , Megri Abderahim Fayçal [2],Lamamra Kheireddine[3]

1 Laboratory of Electrical and Automatic engineering, university of Oum El Bouaghi, Algéria
2 Laboratory of of Theory and Applied Physic LPAT, university of Tebessa, Algéria
3 Laboratory of Mastering of Renewable Energies, University A. Mira. Bejaia Algeria - IEEE Member

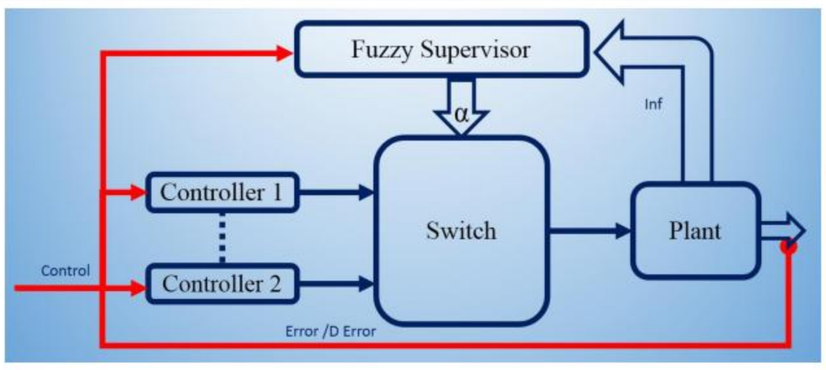
ABSTRACT

In a distrubuted control architecture,the role of a supervisor is to cordinate interactions between local controllers by modifying the structure of the local controllers according to the global information of the system [1] ,The proposed hybrid control scheme is based on a fuzzy supervisor which manages the combination of two controllers according to the error and change in error

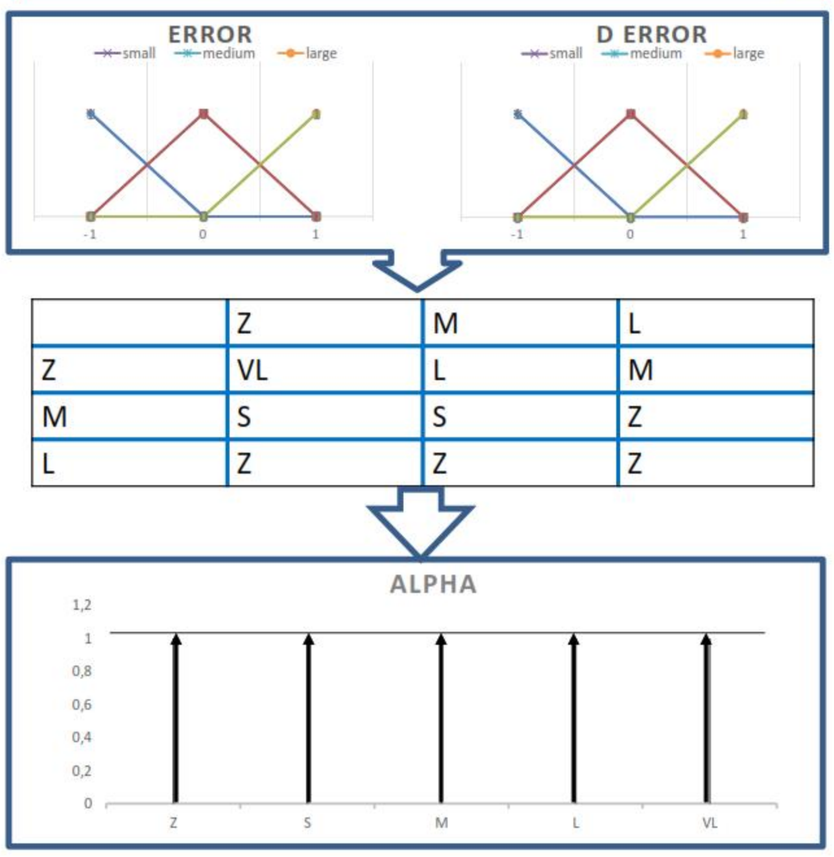
1. INTRODUCTION

our goal in this work is to design a fuzzy supervisor that determines a weighting factor α, which gives the participation rate of each control signal to overcome their disadvantages. Then we will try it on an example of pendulum controlled by LQR and state feedback control, then The fuzzy logic supervisor results are compared to a simpler strategy based only on one controller.

2. SUPERVISOR ARCHITECTURE



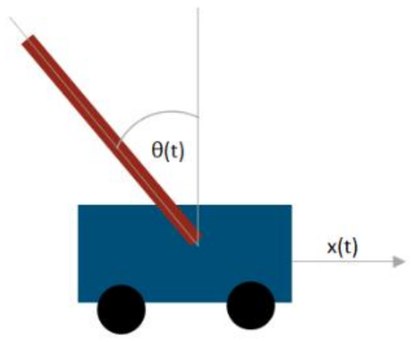
The image above shows the architecture of our fuzzy supervisor that takes the error and the variation of the error as inputs and gives the weighting factor alpha (varies between 0 and 1) as output. In order to construct the fuzzy supervisor, we define firstly the fuzzy sets for each input and output (the error and its derivatives), then the rule base is elaborated[2].



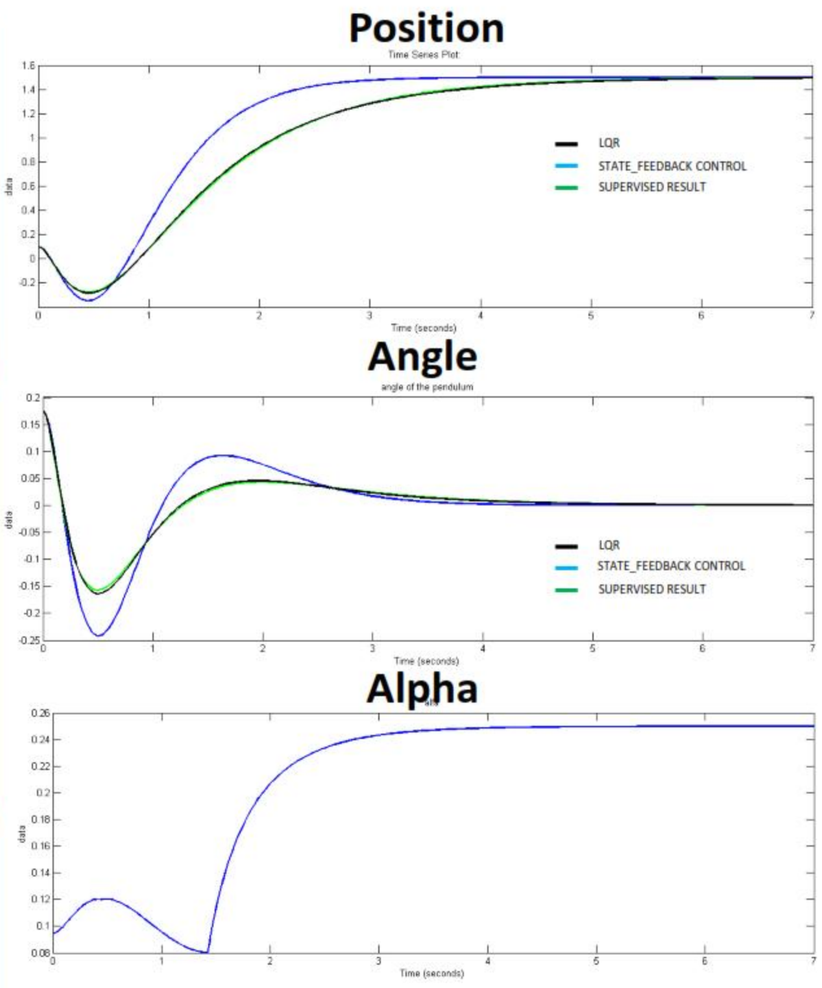
	Z	M	L
Z	VL	L	M
M	S	S	Z
L	Z	Z	Z

3, SIMULATION

A simulation of an inverted pendulum is used to illustrate the proposed approach.



In order to take advantage of two controllers, state feedback control and LQR [3] ,their control actions are combined by means of a weighting factor α ∈ [0 1], representing the output of a fuzzy logic supervisor that takes the tracking error and its time derivatives as inputs. The global control scheme of the proposed approach is illustrated in the supervisor architecture
The folowing photos represent the result of this exemple:



4. INTERPRETATION

These figures show that LQR and the combined controller provide a fast dynamic response compared to the state feedback control, and that LQR and the combined controller provide a smooth variation of the control signal. Hence, the proposed control set-up eliminates the disadvantages of both LQR and state feedback control
It show that the proposed controller ensures a good convergence towards the desired trajectory

5. CONCLUSIONS

In this work, we have developed a hybrid robust controller for a class of nonlinear and disturbed systems. The main idea is the use of a fuzzy supervisor to manage efficiently the action of two controllers, such that the system remains stable and robust despite the plant switching from one mode to a new one.

Furthermore, this structure allows us to take advantage of both controllers and to efficiently eliminate their drawbacks.

Simulation results showed the efficiency and the design simplicity of the proposed approach.

The perspective of this work is the study of the influence of imprecise inputs on the performance of a fuzzy supervisor for the control of nonlinear systems using the fuzzy gradual intervals [4][5] .

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Contact Information

BENNOUR HACHEM
Tel: +213-662051004
Email: hachem.bnr.ii@gmail.com