



**Politecnico  
di Torino**

Project II: distributed control  
of a multi-agents magnetic levitation system

Modeling and control of cyberphysical systems

01UDSOV

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## 1 Introduction

## 2 Abstract

## 3 Set Up

## 4 Distributed regulator based on a distributed neighborhood observer structure

### 4.1 Architecture Design

## 5 Distributed regulator based on local observers

### 5.1 Architecture Design

## 6 Results

### 6.1 Constant reference

### 6.2 Ramp reference

### 6.3 Sinusoidal reference

## 7 Noise Effect

In a real environment system nodes are affected by measurement error. One error source is represented by the noise contribution on the sensor signal. For this project a white noise with normal distribution have been considered with a maximum power of 100mW (taken from the EIRP maximum wi-fi irradiance in the European Union) and assuming a 20mA consumption by the sensor.

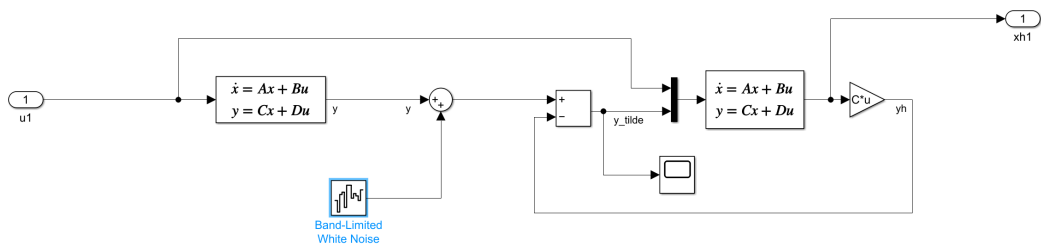


Figure 1: IST

Figure 2: Node structure with noise implementation

We analyzed the effect of the noise in the case of distributed observer and when we rely only on the local observer without neighborhood contribution. What we observed is that the noise attenuation is similar in either cases with the first case better at attenuating the velocity and the second one, which relies on the local observed, better at attenuating the vertical position.

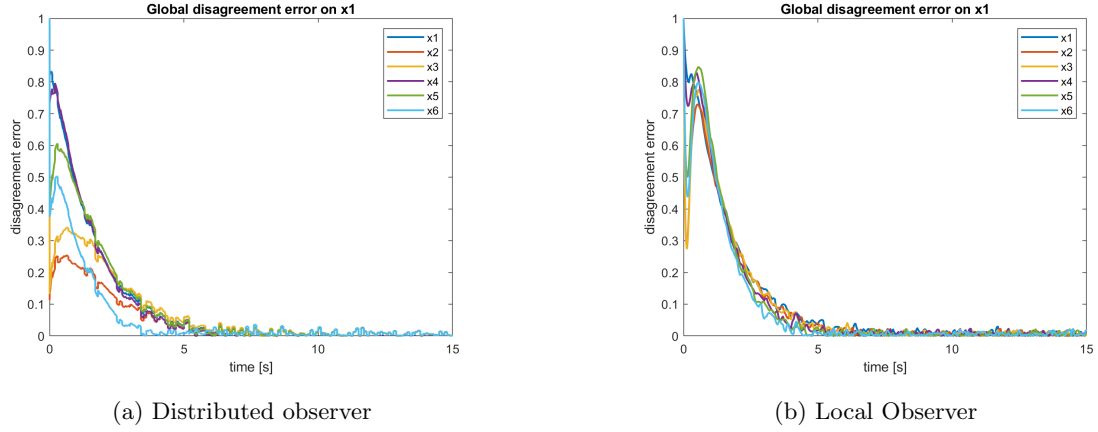


Figure 3: Comparison on vertical position ( $x_1$ ) cumulative disagreement error

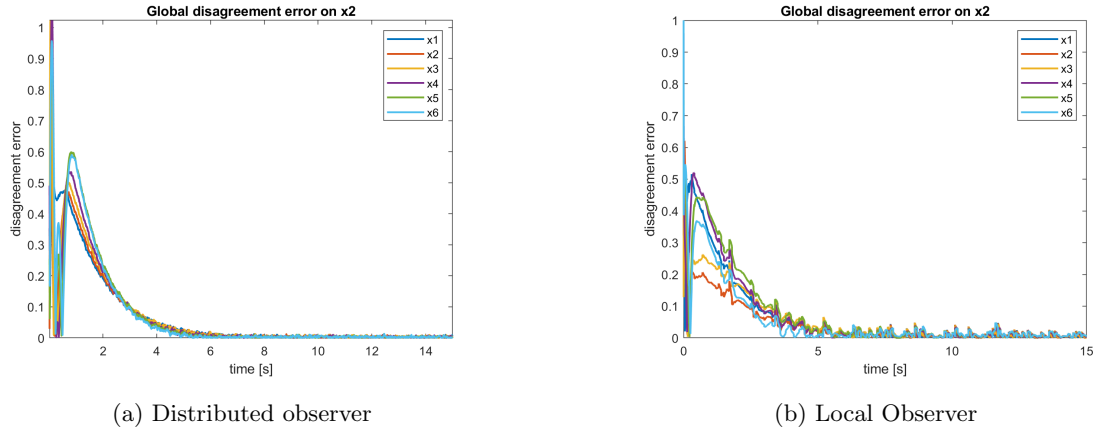
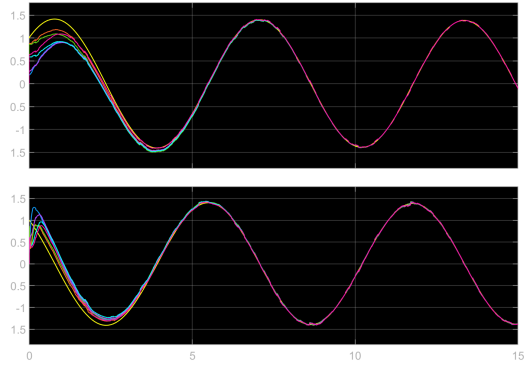
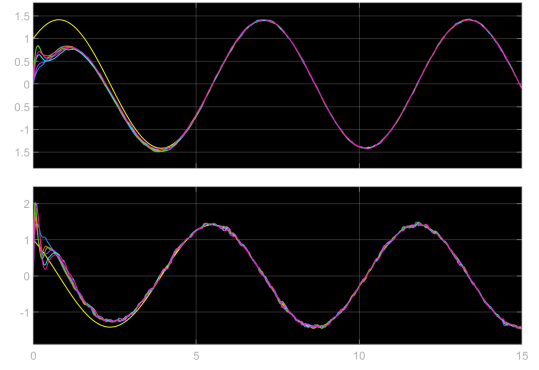


Figure 4: Comparison on velocity ( $x_2$ ) cumulative disagreement error

As can be seen in 5 the results have been performed using as reference a sinusoidal signal. We observed the same behavior also with a constant reference. In conclusion we can say that the network can successfully manage some noise during the measurement process but it isn't able to completely cancel it.



(a) Distributed observer



(b) Local Observer

Figure 5: Sinusoidal reference signal from  $S_0$

## 8 Parameters tuning

### 8.1 Coupling gain

### 8.2 Weighting matrix

## 9 Conclusions