UNIVERSITY OF TRENTO - Italy
Information Engineering
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Master Degree in Computer Science

Applied Robotics

AA 2015-2016

Identification procedure for Lego Mindstorm motor

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December 13, 2015

Abstract

Report for the second assignment on Applied robotics: design and implement controller for the Lego NXT motor.

In this report we show our controller, describe it properties and describe it digital implementation.

1 Design of continues time controller

1.1 Controller requirments

The contoller should have zero stady state tracking error, overshot less than 20% and settling time less than 0.4s. To show overshot requirment on root locus plot we use the folowing formula:

$$\frac{Re}{Im} = \frac{\xi}{\sqrt{1-\xi^2}} = \pm\frac{ln0.2}{\pi} \tag{1}$$

To show settling time requirment, we use dominant pool aproximation:

$$Re = \frac{ln(\alpha)}{0.4} \tag{2}$$

1.2 Our design

$$C(s) = \frac{(s+10)^2}{s(s+21)} \tag{3}$$

$$K_c = 10 \tag{4}$$

You can see root locus in fig. 1, and ideal responce to 1(t) fig. 2. You can also see result of our scicoslab simulation in fig. 3.

2 Implimentation of digital controller

Digital vestion of controller is (obtained using trapezoid rule):

$$\begin{aligned} y_{k+2} = \frac{1}{4+42*T}(&K_c u_{k+2}(4+100T^2+40T) + K_c u_{k+1}(-8+200T^2) \\ &+ K_c u_k(4-40T+100T^2) + 8y_{k+1} - y_k(4-42*T)) \end{aligned} \tag{5}$$

3 Conclusion

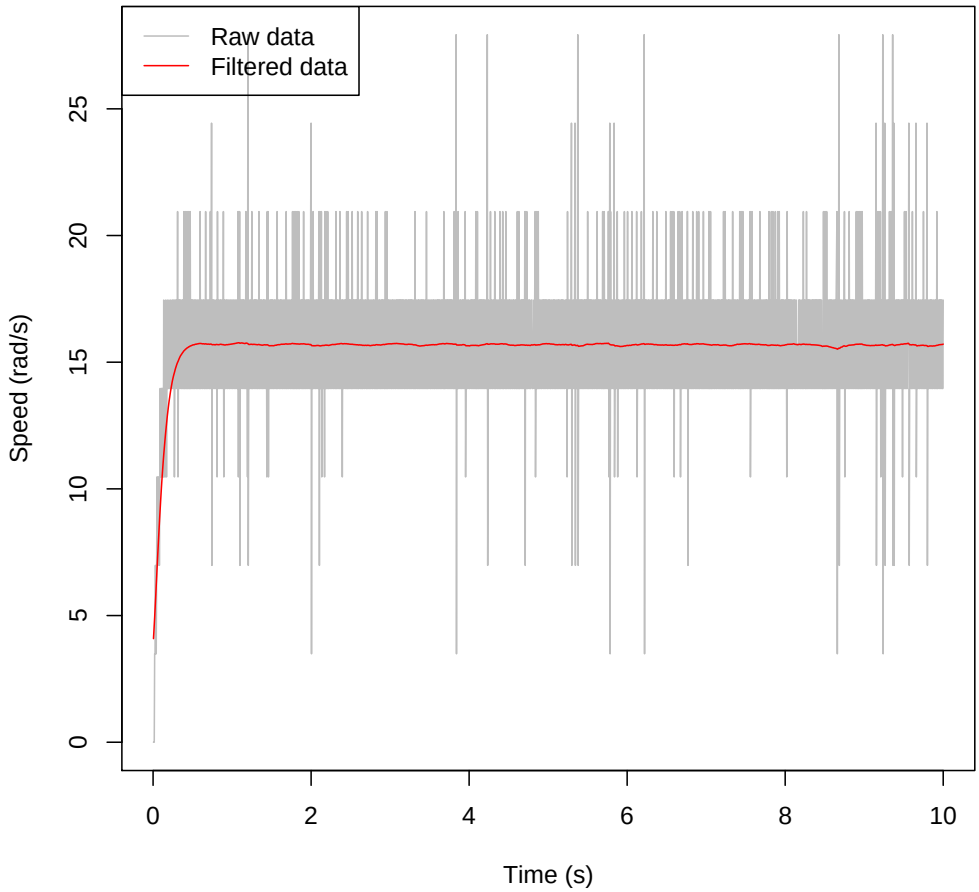

Figure 1: Root locus, blue lines show constains on overshot and settling time

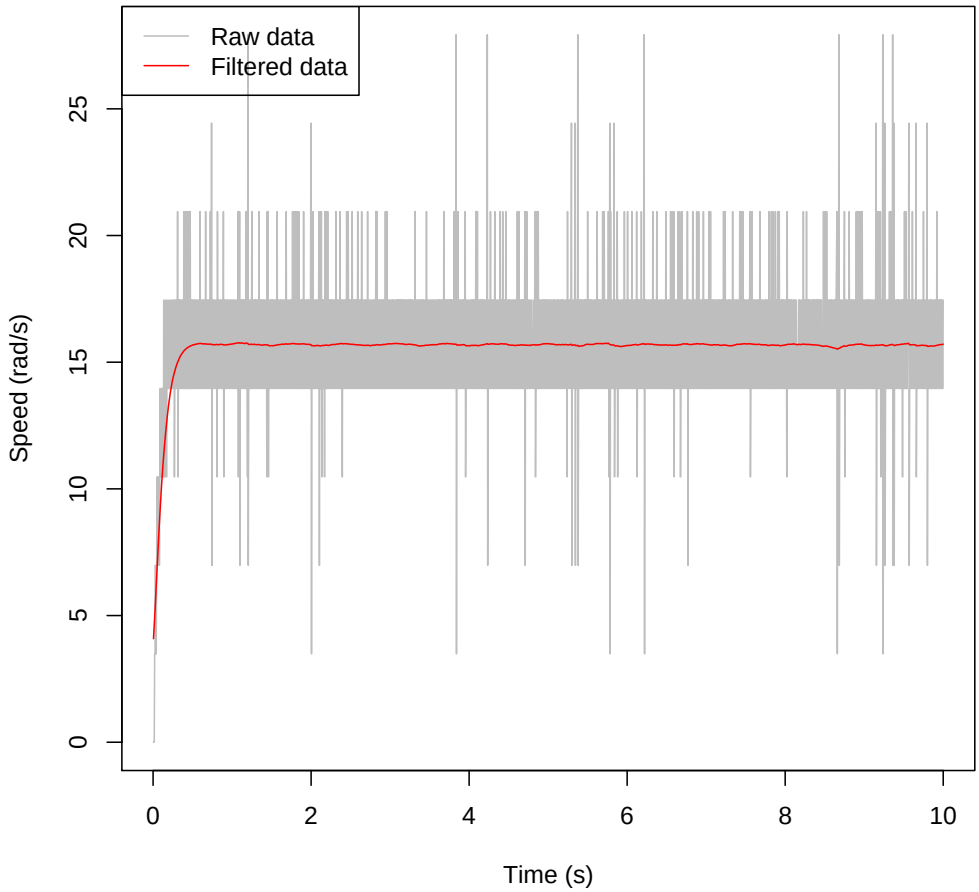

Figure 2: Responce to 1(t).

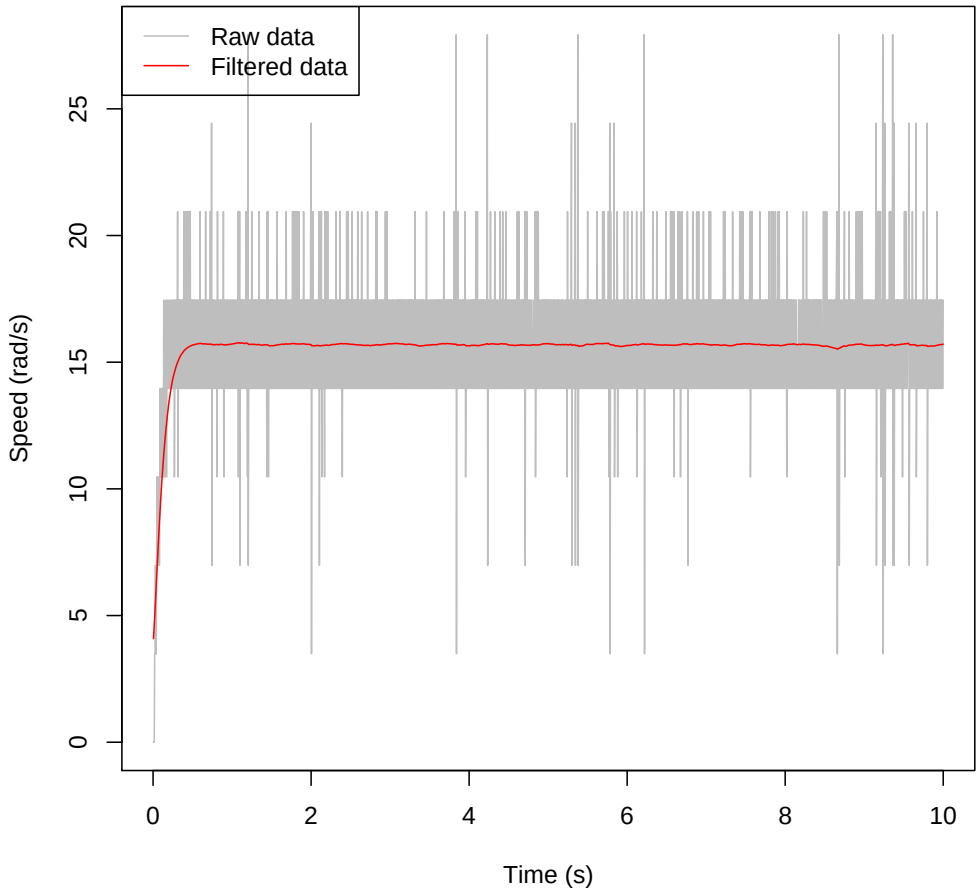

Figure 3: Scicoslab simulation.