COM S 578X: Optimization for Machine Learning
Homework 1

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Problem 1.

Let $x = [r, v, \varphi, \omega]^T$. The nonlinear system can be reformulated in the form of $\dot{x} = f(x) + g(x)u$, where

$$f(x) = \begin{bmatrix} v \\ -g\sin\varphi + r\omega^2 \\ \omega \\ -\frac{2mrv\omega}{J+mr^2} - \frac{mgr\cos\varphi}{J+mr^2} \end{bmatrix}, \; g(x) = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}.$$

Tracking errors of coordinate z are shown in Fig. 1.
Other symbols $\mathbb{R}$, $\mathbb{Q}$, $\mathbb{Z}$, cos, and sin.

Theorem 1. *If f is absolutely continuous, then $\dot{f}(t)$=g(t) almost everywhere in the sense of Lebesgue measure.*

Assumption 1. *If f is absolutely continuous, then $\dot{f}(t)$=g(t) almost everywhere in the sense of Lebesgue measure.*

Remark 1. If f is absolutely continuous, then $\dot{f}(t)$=g(t) almost everywhere in the sense of Lebesgue measure.

Problem 2. If f is absolutely continuous, then $\dot{f}(t)$=g(t) almost everywhere in the sense of Lebesgue measure.

Lemma 1. *If f is absolutely continuous, then $\dot{f}(t)$=g(t) almost everywhere in the sense of Lebesgue measure.*

Corollary 1. *If f is absolutely continuous, then $\dot{f}(t)$=g(t) almost everywhere in the sense of Lebesgue measure.*

Proof. Here is my important proof □

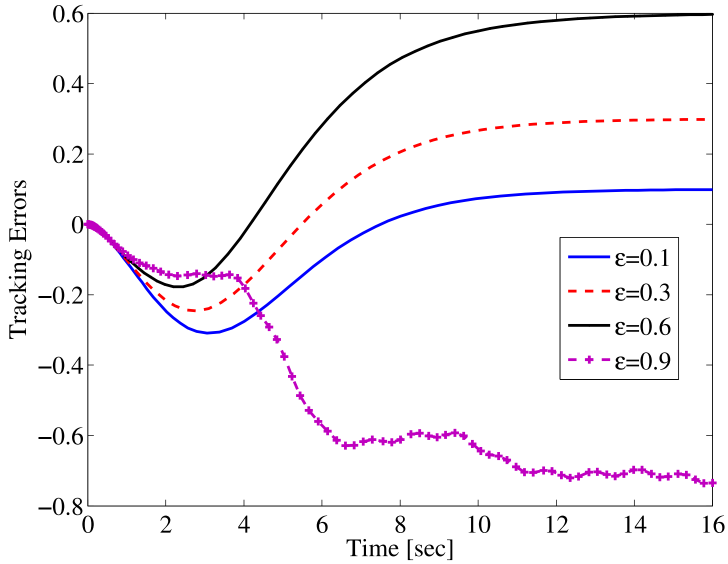

Figure 1: Tracking errors of the z coordinate with different ε