Department of Engineering Cybernetics

TTK4215 Adaptive Control
Assignment 1

Problem 1

Problem 4.2 in Ioannou & Sun.

Hint: Read section 4.2.3 in the book. This problem includes simulating a parameter estimator. Matlab code to get you started has been posted to Blackboard.

Problem 2

Problem 4.3 in Ioannou & Sun.

Hint: Take a look at section 4.2.2 in the book. Try to rewrite the system to satisfy Equation (4.2.12). Some filtering might be needed..

Problem 3

Suppose that $V : [0, \infty) \to \mathbb{R}$ is non-increasing and that $V(t) \geq 0$ for all $t \geq 0$. Show that $\lim_{t\to\infty} V(t)$ exists and is finite.

Hint: Make use of the infimum ("greatest lower bound") of V (convince yourself it exists), and the fact that after some (finite) time t', $V(t')$ will be arbitrarily close to this infimum.

Problem 4

Problem 4.1 in Ioannou & Sun (Challenging).

Hint: See page 150, and in particular, Equation (4.2.10) will be needed.

Partition time into n pieces of length T_0, where n is a non-negative integer. Since t is not necessarily a multiple of T_0, you have to add a small amount, i.e. $nT_0 \leq t < (n+1)T_0$. By defining $t_1 = nT_0$, you should be able to use the information given in the problem.

Note that the problem asks you to show that (4.2.11) is a necessary *and* sufficient condition (if and only if). That means that the proof has two parts and you have to show the implication both ways. For statements A and B, A if and only if B can be proven if you show that $B \Rightarrow A$ and $A \Rightarrow B$ (equivalently $\neg B \Rightarrow \neg A$).