**ENME 621**

Robust and Adaptive Linear Control — Prof. M. Krstic

## Homework 7

Due December 5, 1995

1. Ioannou & Sun, Problem 6.13.
   Do only parts (a), (b), and (e). In part (e), simulate both the designs from (a) and (b) and compare.

2. Ioannou & Sun, Problem 6.16.
   Important result: shows that, if the plant is relative degree one and minimum phase, you only need a static output-feedback controller with an adaptive gain which is "pumped-up" to a sufficient level by the nondecreasing update law $\dot{\theta} = y_p^2$. Additional hint: use Lyapunov function
   $$V = x_1^{\mathrm{T}} P x_1 + \frac{1}{2} y_p^2 + \frac{|k_p|}{2} (\theta - M)^2 \,,$$
   where $M$ is an arbitrarily large constant to be selected.