ENME 621
ROBUST AND ADAPTIVE LINEAR CONTROL — Prof. M. Krstic

FINAL EXAM: Adaptive Control

December 7, 1995

Open books and notes. Total points: 25. Time 3:30–4:50.

1. (13 points)
Problem 7.5, Parts (a) and (b), in *Ioannou & Sun*.
Take all filter poles and desired closed-loop poles to be at $s = -2$.

2. (12 points)
In the relative-degree-one minimum-phase plant

$$W_{\mathrm{p}}(s) = \frac{Z_{\mathrm{p}}(s)}{R_{\mathrm{p}}(s)}$$

the numerator $Z_{\mathrm{p}}(s)$ is known and the reference model $W_{\mathrm{m}}(s) = \dfrac{Z_{\mathrm{m}}(s)}{R_{\mathrm{m}}(s)}$ is chosen such that $Z_{\mathrm{m}}(s) = Z_{\mathrm{p}}(s)$. (All the above polynomials are monic.)

(a) Assume that $R_{\mathrm{p}}(s)$ is also known and show that the nonadaptive MRC problem can be solved with a controller of the form

$$u(s) = r(s) + \frac{Z_{\mathrm{c}}(s)}{R_{\mathrm{c}}(s)} y(s)\,.$$

Derive the matching conditions for the coefficients of Z_{c} and R_{c}.

(b) When a single coefficient of $R_{\mathrm{p}}(s)$ is unknown design an adaptive (MRAC) controller with only one adjustable parameter. Give an update law and discuss stability.