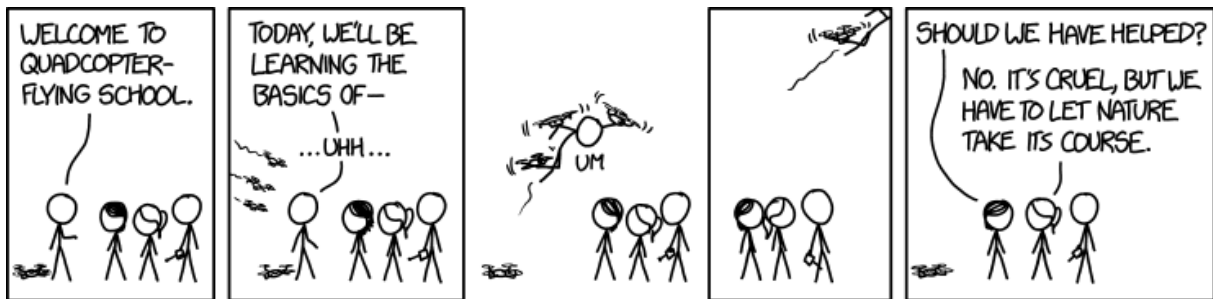


# 2018 MPC Programming Exercise

## Quadrotor Control



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## 1 Q1 - Interpretation of Linearized System

*Interpretation of the structure of matrices  $A^c$  and  $B^c$ . Explain in particular the nonzero rows 4 and 5 of  $A^c$  and the nonzero rows of  $B^c$  in connection with the nonlinear dynamics described above. 2.5%*

## 2 Q2 - Choice of Tuning Parameters

*Choice of tuning parameters ( $Q, R, P, A_{\mathcal{X}_f}, b_{\mathcal{X}_f}$ ) and motivation for them. 5%*

## 3 Q3 - Initial Reponse Plots

*Plots of the response starting from the given initial condition  $x^1(0)$ . 10%*

## 4 Q4 - Steady State Reference Tracking

*Define the steady state  $(x_r, u_r)$  as a function of  $n$  arbitrary reference  $r^1$ . 5%*

## 5 Q5 - Reference Signal Plots

*Plots of the response or the constant reference signal  $r^1 = [1.0000 \ 0.1745 \ -0.1745 \ 1.7453]^T$ . 10%*

## 6 Q6 - Varying Reference Signal Plots

*Plots of the response for the slowly varying reference signal  $r^1(k) = [1 \ 0.1745 \cdot \sin(T_s k) \ -0.1745 \cdot \sin(T_s k) \ \pi/2]^T$ . 2.5%*

## 7 Q7 - Nonlinear Model Reference Tracking

*Plots of a reference tracking response of the nonlinear model. 5%*

## 8 Q8 - Disturbance Observer Design

*Provide the matrix  $L$  and justify your choice. 5%*

## 9 Q9 - Reference Signal Plots

*Plots of the response or the constant reference signal  $r^1 = [0.8 \ 0.12 \ -0.12 \ \pi/2]^T$ . 10%*

## 10 Q10 - Varying Reference Signal Plots

*Plots of the response for the slowly varying reference signal*

$$r^1(k) = [0.8 \ 0.12 \cdot \sin(T_s k) \ -0.12 \cdot \sin(T_s k) \ \pi/2]^T. \quad \mathbf{2.5\%}$$