

# AA 274A: Principles of Robot Autonomy I

## Problem Set X

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### Problem 1

- (i) We are given initial and final conditions in terms of variables  $\{x, y, V, \theta\}$ . The equations are:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & t_f & t_f^2 & t_f^3 \\ 0 & 1 & 2t_f & 3t_f^2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} x(0) \\ \dot{x}(0) \\ x(t_f) \\ \dot{x}(t_f) \end{bmatrix}$$
$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & t_f & t_f^2 & t_f^3 \\ 0 & 1 & 2t_f & 3t_f^2 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} = \begin{bmatrix} y(0) \\ \dot{y}(0) \\ y(t_f) \\ \dot{y}(t_f) \end{bmatrix}$$

where  $\dot{x}(t) = V \cos \theta$  and  $\dot{y}(t) = V \sin \theta$  as given by the robot's kinematic model.

- (ii) Since  $\det(J) = V$ ,  $V > 0 \forall t$  is a sufficient and necessary condition for the matrix  $J$  to be invertible.
- (iii) (code)
- (iv) (code)
- (v) TODO
- (vi) TODO

### Problem 2

### Problem 3