

# ELL 801: Nonlinear Control

## HW #3

Due on February 2, 2024

1. **(Feedback linearization)** Consider the system

$$\dot{x}_1 = -x_1 + x_2$$

$$\dot{x}_2 = x_1 - x_2 - x_1 x_3 + u$$

$$\dot{x}_3 = x_1 + x_1 x_2 - 2x_3$$

Do the following:

- (a) show that the system is feedback linearizable (without finding any output function).
- (b) find a change of coordinates that puts it in linear form.
- (c) design a state feedback control law that *globally* stabilizes the origin.

2. **(Asymptotic regulation)** Consider the following SISO nonlinear system

$$\dot{x}_1 = x_2 + \sin x_1$$

$$\dot{x}_2 = x_1^2 + \gamma u$$

$$y = x_1,$$

where  $\gamma$  is a given scalar. Design a continuous feedback controller via feedback linearization so that the output  $y$  asymptotically tracks the signal  $r(t) = \sin t$ . Plot evolutions of your design from 3 different initial conditions.