

## Additional Exercises for Chapter 14

1. Consider the second-order system

$$\begin{aligned}\dot{x}_1 &= x_2 \\ \dot{x}_2 &= \psi(x_1, x_2) + u\end{aligned}$$

where  $\psi$  is an unknown function that satisfies  $|\psi(x_1, x_2)| \leq x_1^2 + x_2^2$  for all  $x$ .

- (a) Design a state feedback, continuous, sliding mode control to globally stabilize the origin.
  - (b) Estimate how small  $\varepsilon$  should be to ensure asymptotic stability of the origin.
2. Consider the second-order system

$$\begin{aligned}\dot{x}_1 &= x_1 + \frac{x_2}{1 + x_1^2} \\ \dot{x}_2 &= -x_2 + u\end{aligned}$$

Using backstepping, design a globally stabilizing state feedback control law.