

### Homework #3:

Complete the following:

1. Problem 4.55 (1)
2. Problem 4.61 in HK
3. Explain the steps to the proof of the small-gain theorem (HK Theorem 5.6, page 218). The proof is all there, but it is a bit sparse in explanation and he sometimes jumps over algebraic manipulations. You should explain how Khalil goes from one step to another (filling steps in if needed) and summarize why this is an important result.
4. Problem 5.3 in HK
5. Problem 5.5 in HK
6. Problem 5.10(3) in HK
7. Problem 12.2(1) in HK
8. The stereographic projection is a mapping that projects a sphere onto a plane. The projection is defined everywhere on the sphere except for one point, called the projection point.
  - (a) Use the North Pole as the projection point, show that the stereographic projection of a point  $(y_1, y_2, y_3)$  on the unit sphere is

$$(x_1, x_2) = \left( \frac{y_1}{1 - y_3}, \frac{y_2}{1 - y_3} \right)$$

Where  $(x_1, x_2)$  are coordinates on the plane.

- (b) Derive the inverse stereographic transformation that maps from  $(x_1, x_2)$  to  $(y_1, y_2, y_3)$ .