Ratio control: Ammonia synthesis reactor

Lecture notes for Advanced modeling and Control

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# 1. Example 15.1 from ([Seborg et al. 2016](#ref-seborg2016))

A ratio control scheme is to be used to maintain a stoichiometric ratio of H2 and N2 as the feed to an ammonia synthesis reactor [Figure 1](#fig-nh3-synthesis). Individual flow controllers will be used for both the H2 and N2 streams. Using the information given below,

1. Draw a schematic diagram for the ratio control scheme.
2. Specify the appropriate gain for the ratio station, $K\_{R}$.

## 1.1 Available information:

1. The electronic flow transmitters have built-in square root extractors. The spans of the flow transmitters are 30 L/min for H2 and 15 L/min for N2.
2. The control valves have pneumatic actuators.
3. Each required current-to-pressure (I/P) transducer has a gain of 0.75 psi/mA.
4. The ratio station is an electronic instrument with 4–20 mA input and output signals.

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| Figure 1: Ammonia synthesis reactor |

## 1.2 References

Seborg, Dale E., Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle III. 2016. *Process Dynamics and Control*. John Wiley & Sons. <https://books.google.com?id=ZZVFEAAAQBAJ>.