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Advanced Process Control

CBEg 6142

School of Chemical and Bio-Engineering
Addis Ababa Institute of Technology
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Chapter 4

Ratio Control

Ratio Control: Introduction

- Ratio control is a special type of feedforward control whose objective is to maintain the ratio of two process variables at a specified value.

- The two variables are usually flow rates, a manipulated variable u and a disturbance variable d. Thus, the ratio

$$R = \frac{u}{d} \qquad (4.1)$$

is controlled rather than the individual variables.

Ratio Control: Introduction

- In equation *(4.1)* u and d are physical variables, not deviation variables.

Typical applications of ratio control

- specifying the relative amounts of components in blending operations
- maintaining a stoichiometric ratio of reactants to a reactor
- keeping a specified reflux ratio for a distillation column
- holding the fuel-air ratio to a furnace at the optimum value.

Ratio Control: Method I

- Ratio control can be implemented in two basic schemes.

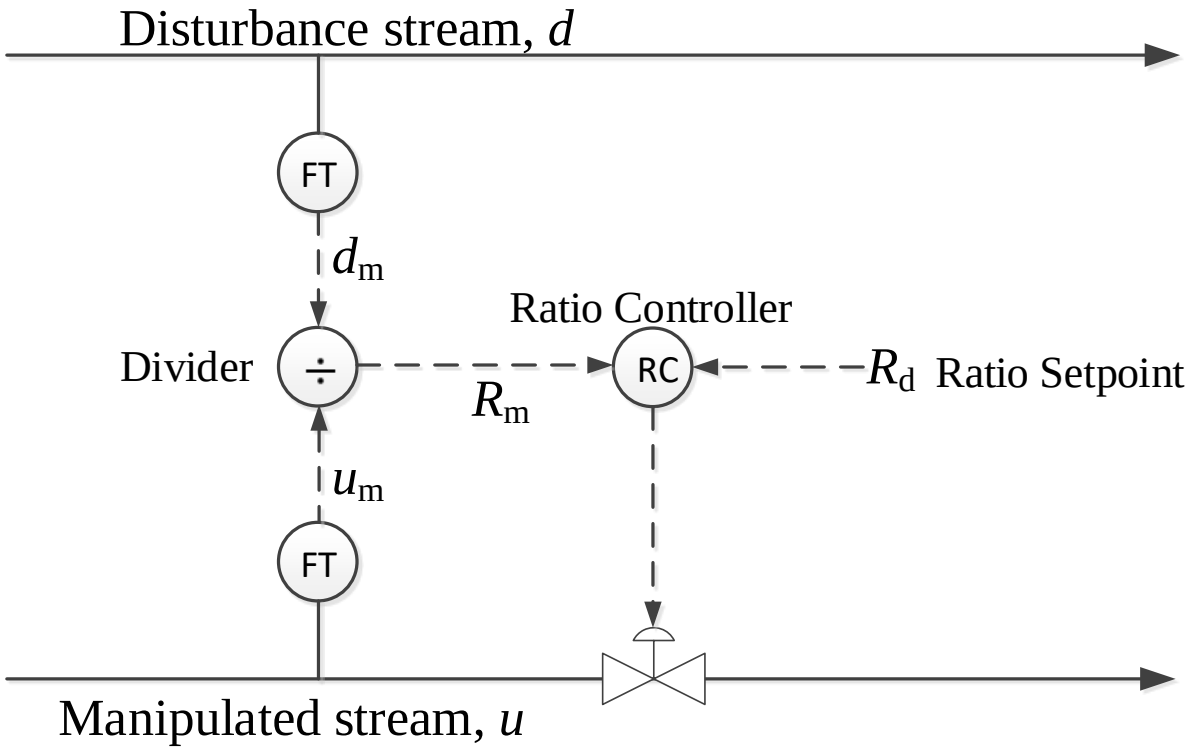

Figure 4.1 Ratio control, Method I.

Ratio Control: Method II

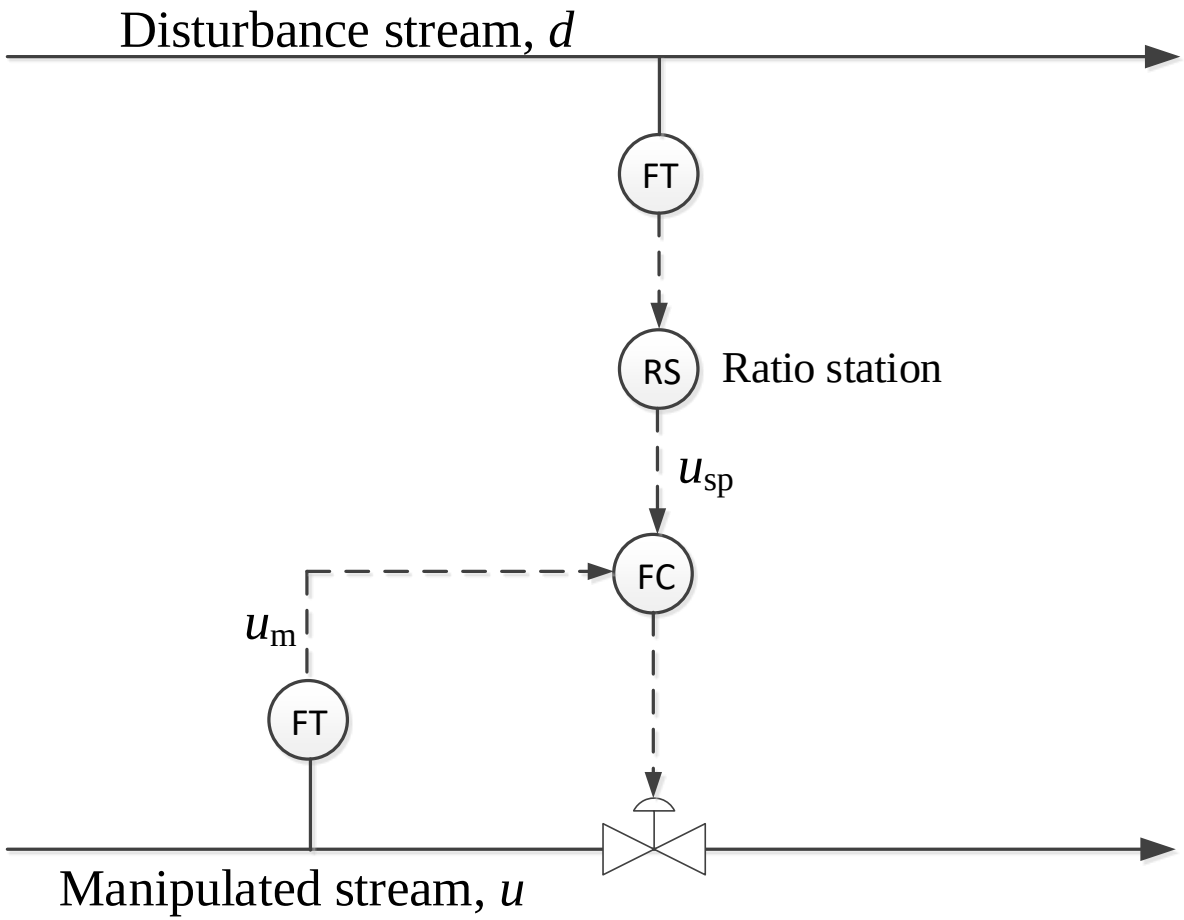

Figure 4.2 Ratio control, Method II.

Ratio Control: Method I vs II

- The main advantage of Method I is that the measured ratio *Rm* is calculated.

- A key disadvantage is that a divider element must be included in the loop, and this element makes the process gain vary in a nonlinear fashion.

$$K_p = \left(\frac{\partial R}{\partial u}\right)_d = \frac{1}{d} \qquad (4.2)$$

- It is inversely related to the disturbance flow rate *d*.

Ratio Control: Method I vs II

- Because of this significant disadvantage, the preferred scheme for implementing ratio control is Method II, which is shown in Fig. 15.6.