Lecture 03.02 Zeroth-order measurement systems

In special cases, we can consider measurement systems to be modeled by *zeroth*-order "differential" equations—that is, by algebraic systems.

If both input u *and* output y are static, the time-derivatives of Equation 03.2 are zero. This leaves the input-output equation, with $K \in \mathbb{R}$ in the form

$$y = Ku. \tag{03.9}$$

static sensitivity

We call K the *static sensitivity*. Technically, the input needn't be static, but one would question the efficacy of a measurement system that has a dynamic input and a static output. In fact, we have assumed neither input nor output changes. This can be approximately true if we calibrate and measure only in steady-state.

Another way to have Equation 03.9 as our model is if we assume there are no energy storage or dissipative elements. This type of measurement system does not exist, but in certain situations it can be considered approximately valid.

Example 03.02-1 zeroth or not?

Explain conditions under which the following systems can be considered zeroth-order.

1. A bulb thermometer.
2. A mass balance.
3. A speedometer.