General Characteristics

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1 Wheeler & Ganji, pp.6-33

Read all of chapter 2 carefully. The rest of the course will be expansion to *specific* characteristics.

1.1 General System

Examine Fig. 1. This is an attempt to fit much of chapter 2 into a single picture. Other concepts are itemized below.

- Like beauty, perfect accuracy unnecessary. Otto Röschel says, "Anything, that makes a man more beautiful than an ape, is pure luxury."

- The tri-modular separation in Fig. 1 is usually obvious in modern electronic systems.

- "Range" means *useable* from-to values of measurand, V_{min}, V_{max}.

- "Span" means $S_p = V_{max} - V_{min}$.

Thermometer "paradigm"

"Front end"   "Back end"

-30   0 (C)   40

Input signal
Measureand
Observed variable(s)   Output signal
Temperature   Observer
Pressure   Archive
Displacement   Database
Velocity   Postprocessor

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sensor  →  condi-  →  display
           tioner
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An instrument is an artificial sensory subsystem   Data record or log
for creatures, natural and artificial.   Feedback signal

Acceleration
Force   Problem

Voltage   E=error $E = V_o - V_t$ Do a parabolic fit on the V_a
Current E_r =random error $E_r = V_o - V_a$ calibration curve you obtained
Fluid flow rate E_s =systematic error $E_s = V_a - V_t$ for P2.25. Use the end points
pH V_o =observed value   and one of maximum deviation.
Frequency V_t =true value   Comment on the coefficient
Time V_a =average value   of x^2 (N).
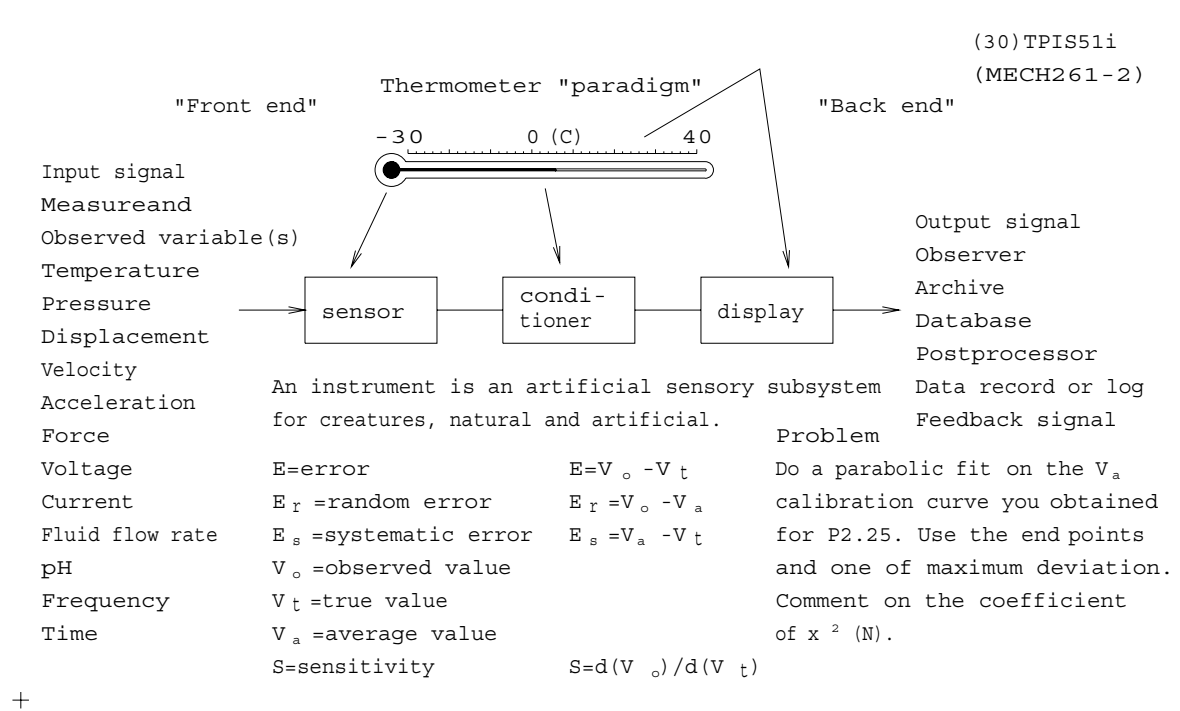   S=sensitivity $S = d(V_o)/d(V_t)$

Figure 1: The System Represented by a Thermometer

- "Spatial error" means that accurate thermometer on the wall may measure something other than average room temperature.

- "Accuracy" is $V_{o(max)} - V_t$, often expressed as the fraction $\pm \dfrac{V_{o(max)}}{V_{t(max)}}$ or the % it represents. See Figs. 2.3,2.4.

- "Precision" is like accuracy but pertains to E_r as opposed to E. A precise instrument can be made accurate via "Calibration".

- See Example 2.3 and Figs. E23. Your first problem is summarized in Fig. 2.

A linear fit $y = ax + b$ may be established as follows.

$$a = \frac{n \sum_{i=1}^{n} x_i y_i - \sum x_i \sum y_i}{n \sum x_i^2 - (\sum x_i)^2}, \quad b = (\sum y_i - a \sum x_i)/n$$
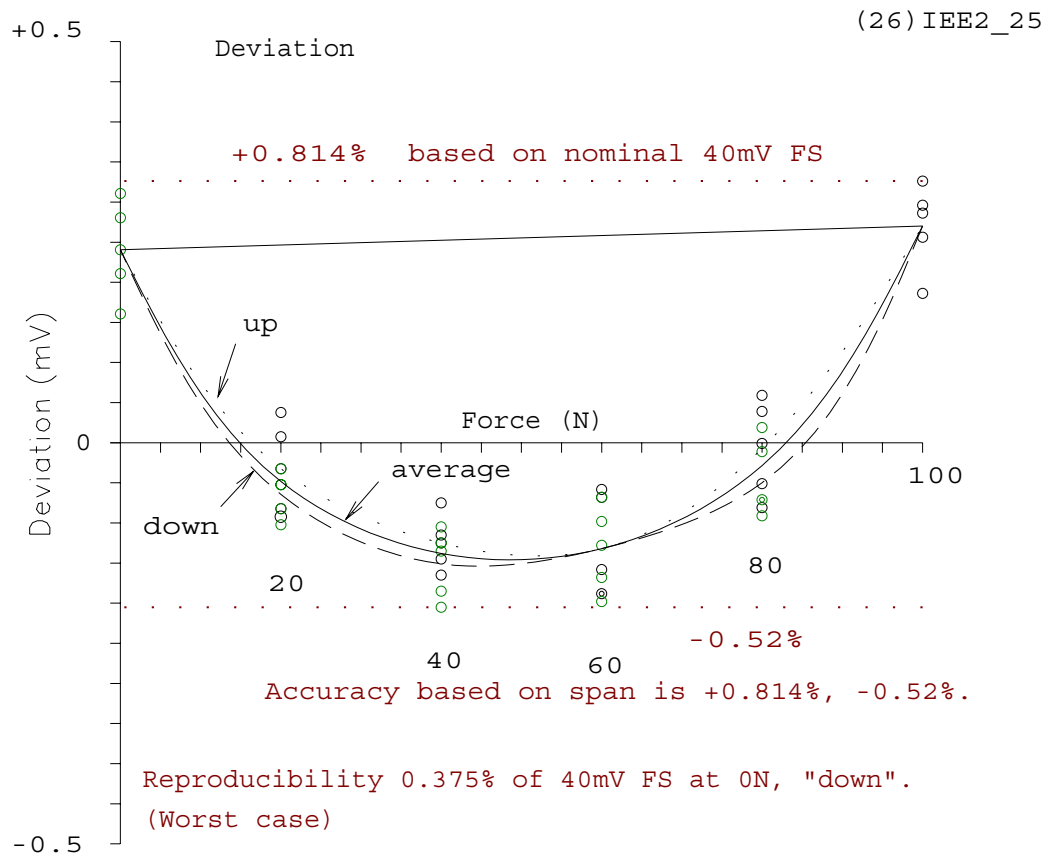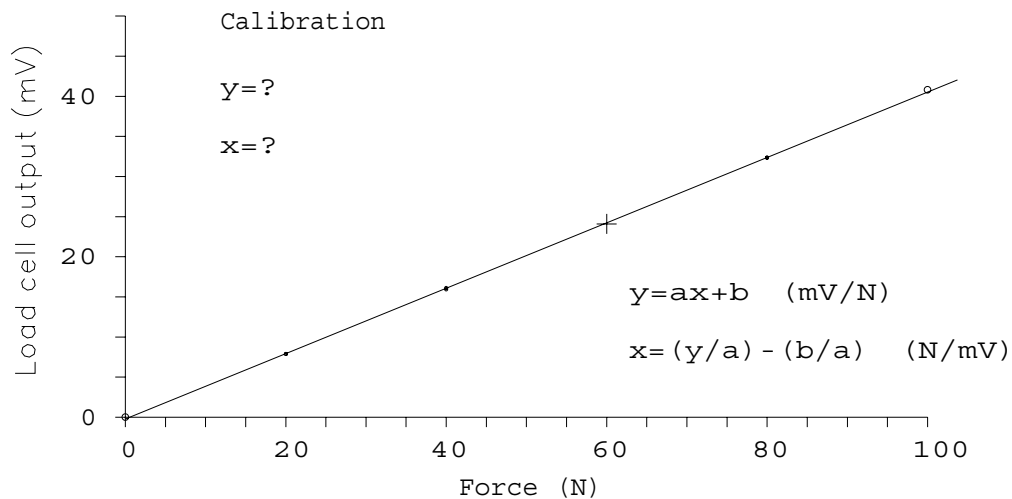
Figure 2: The System Represented by a Thermometer