STRAY FIELD CORRECTOR: CONCEPTUAL DESIGN

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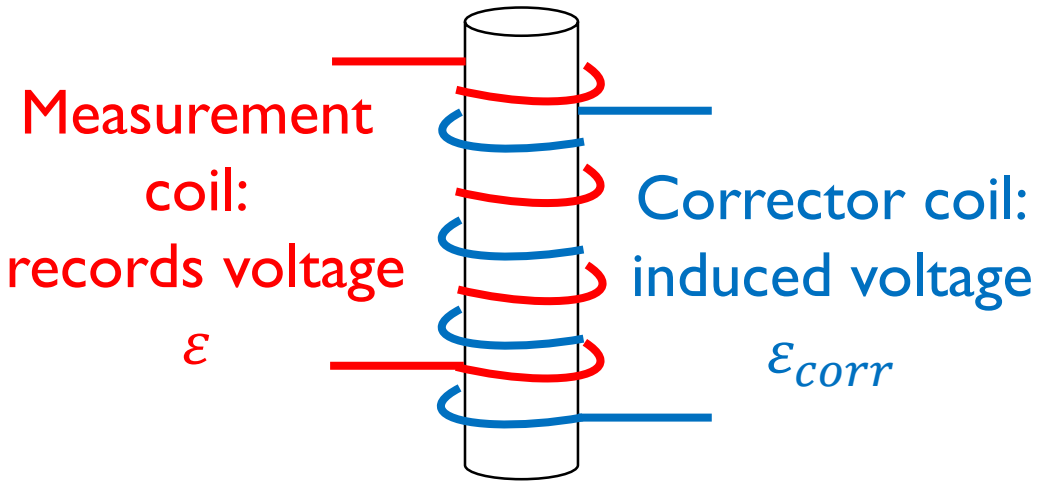
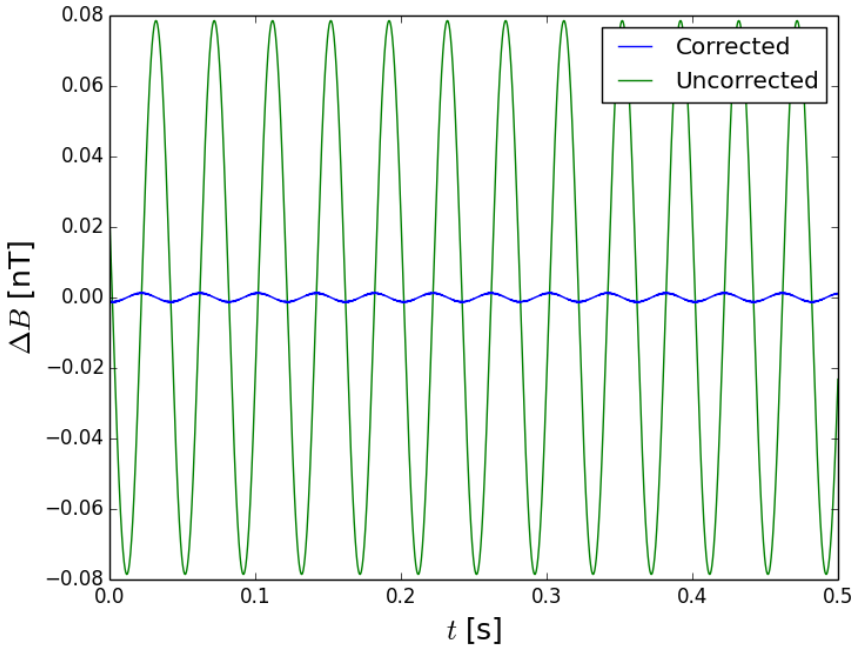
BASIC IDEA

Steps:

1. Stray field induces a voltage ε.
2. ε is used to calculate ε_{corr}.
3. A magnetic field (corrector field) is generated by the corrector coil by applying ε_{corr}.
4. ε is now the voltage induced from the stray field and corrector field.
5. Reiterate…

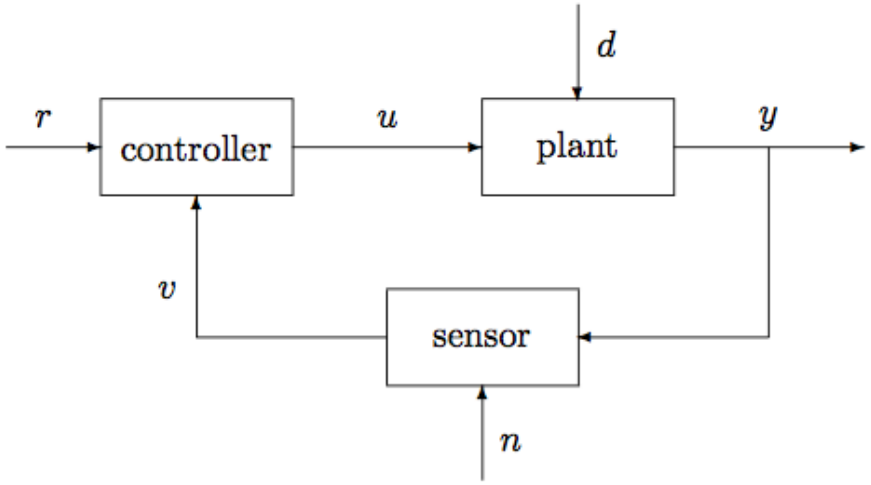




Stray Field: 5nT, 25 Hz

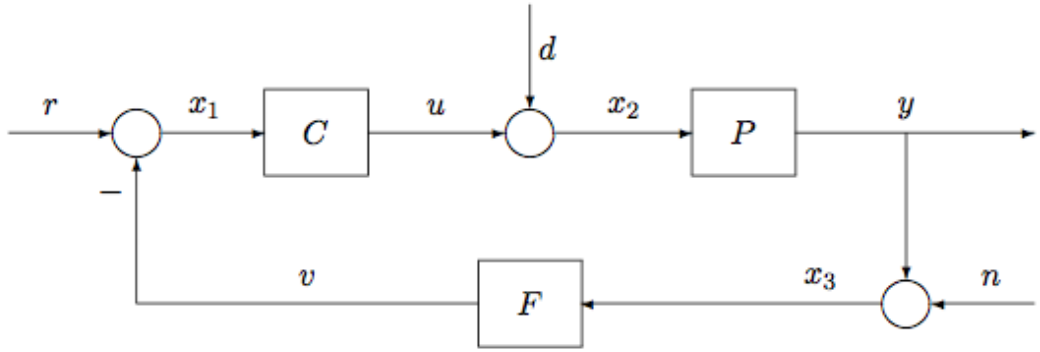
10 kHz sampling frequency

STANDARD FEEDBACK LOOP



r	reference or command input
v	sensor output
u	actuating signal, plant input
d	external disturbance
y	plant output and measured signal
n	sensor noise

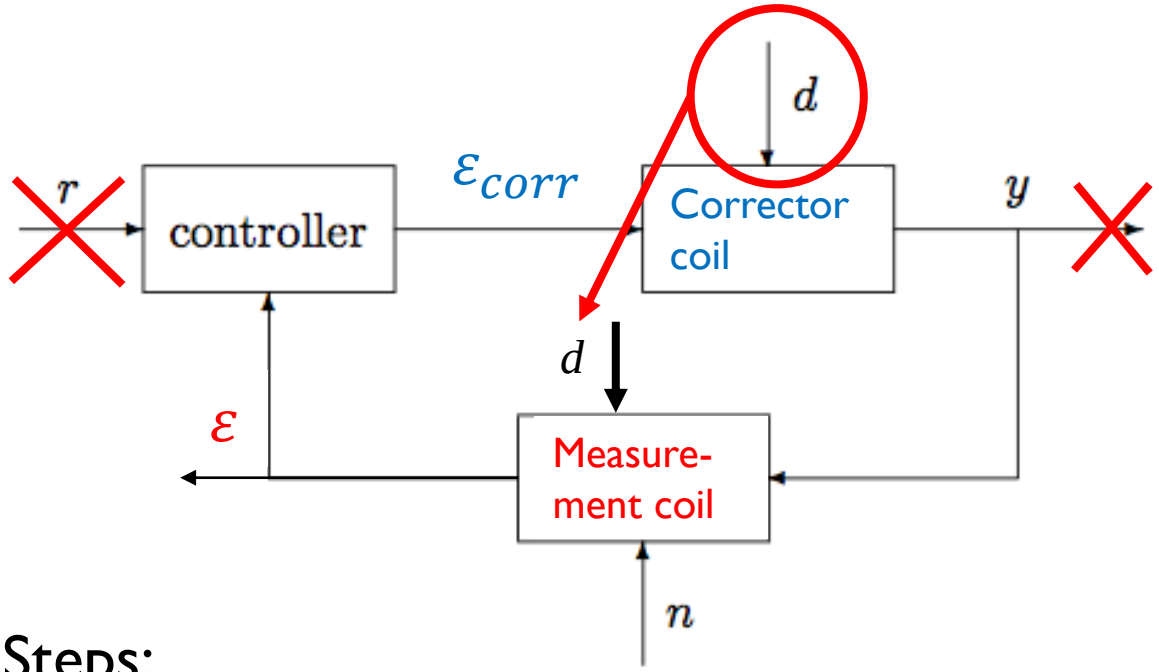
N. B. There are two inputs for each component.

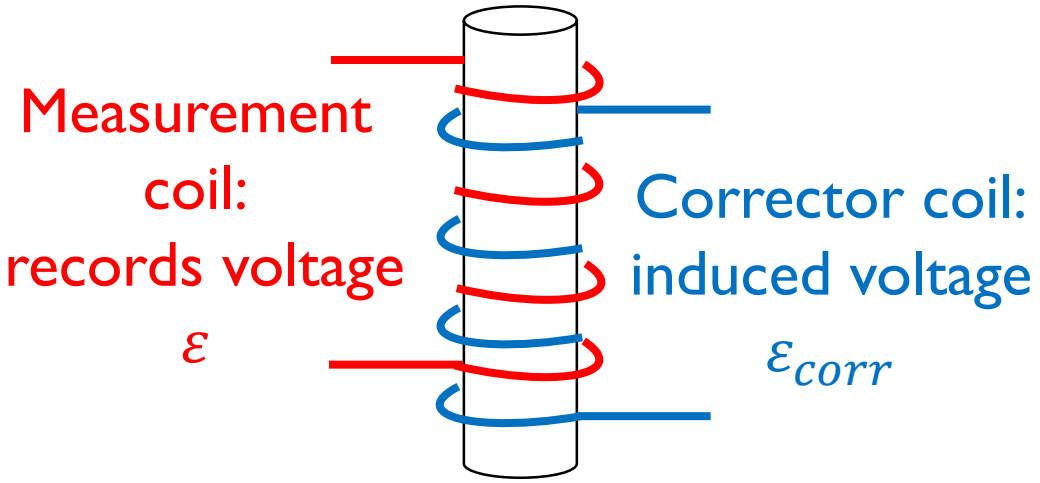


$$\begin{aligned} x_1 &= r - Fx_3, \\ x_2 &= d + Cx_1, \\ x_3 &= n + Px_2. \end{aligned} \quad \Longrightarrow \quad \begin{bmatrix} 1 & 0 & F \\ -C & 1 & 0 \\ 0 & -P & 1 \end{bmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{pmatrix} r \\ d \\ n \end{pmatrix}$$

System is well-posed if this is non-singular

STRAY FIELD CORRECTOR FEEDBACK LOOP





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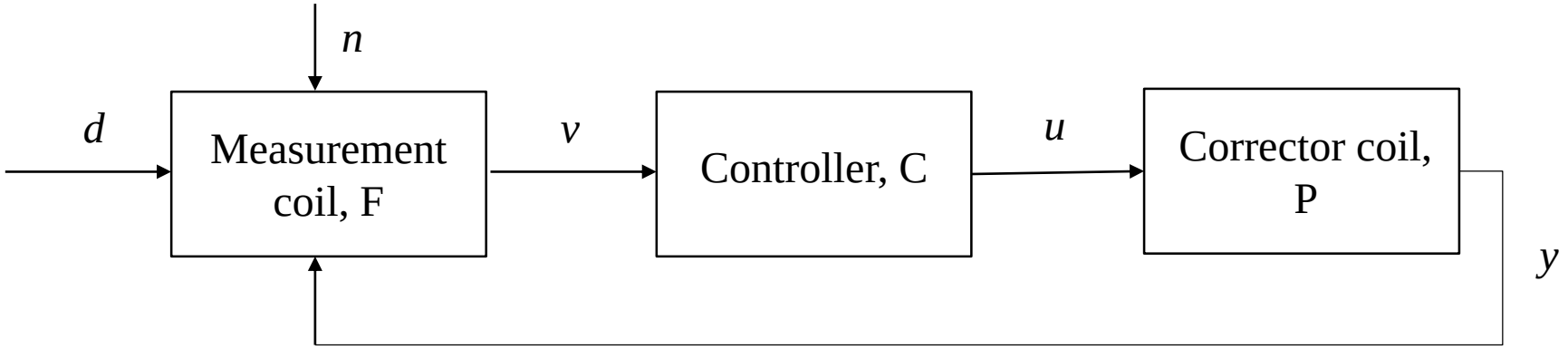

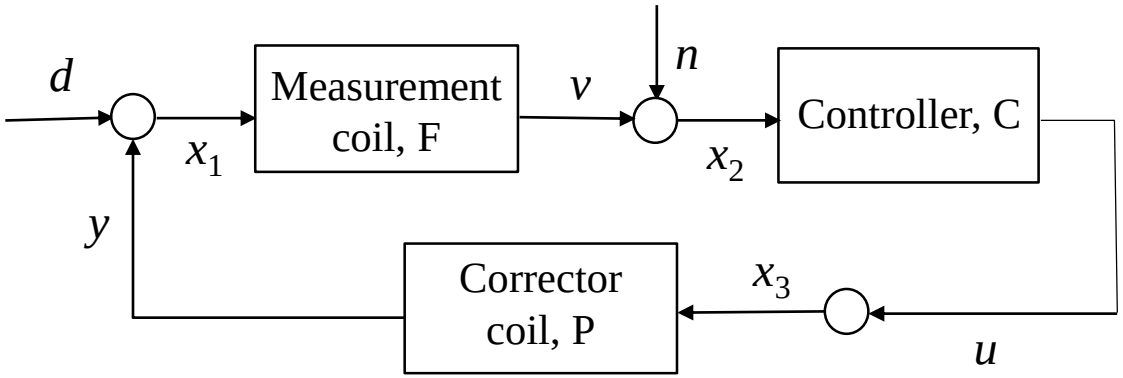

$x_1 = d + Px_3$
$x_2 = n + Fx_1$
$x_3 = Cx_2$

$$\Longrightarrow \begin{pmatrix} d \\ n \\ 0 \end{pmatrix} = \begin{pmatrix} 1 & 0 & -P \\ -F & 1 & 0 \\ 0 & C & -1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

Determinant = -1 + PFC