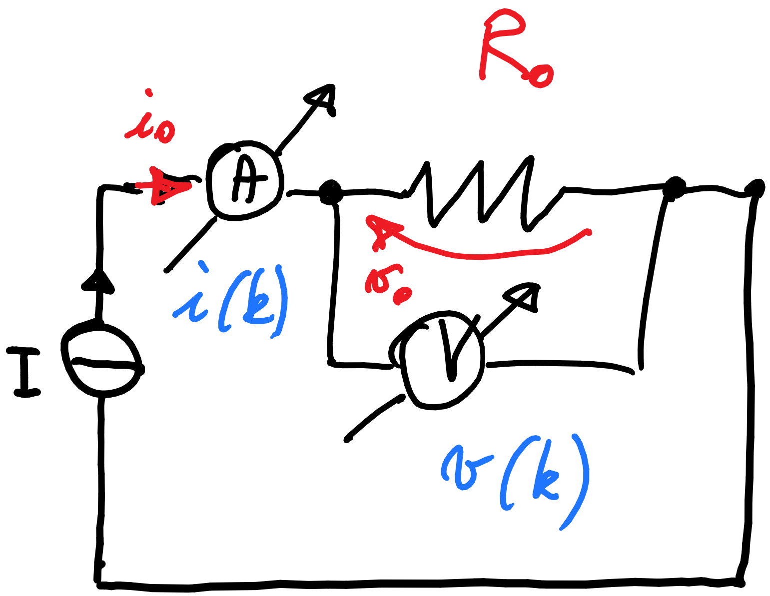
Stima del valore della resistenza di un resistore



$$R_0 = 1\,\Omega$$

$$v_0 = R_0 i_0$$

$$i(k) = i_0 + n_i(k)$$

$$v(k) = v_0 + n_v(k)$$

indip.

$$n_i(k) \sim \mathcal{G}(0, \sigma_i^2)$$

$$n_v(k) \sim \mathcal{G}(0, \sigma_v^2)$$

$$\hat{R} = ?$$

1° stimatore

stimatore "istantaneo"

$$\hat{R}_k = \frac{v(t)}{i(t)}$$

$$\hat{R}_k \xrightarrow[t \to +\infty]{} \;?$$

2° stimatore

stima ai minimi quadrati

$$J_{LS}^{(N)}(R) = \frac{1}{N} \sum_{k=1}^{N} \left[v(k) - R\, i(k) \right]^2$$

$$\hat{R}_{LS}(N) = \frac{\sum_{k=1}^{N} v(k)\, i(k)}{\sum_{k=1}^{N} i^2(k)}$$

3° stimatore

Stima a massima verosimiglianza

$$\hat{R}_{ML}(N) = \frac{\frac{1}{N}\sum_{k=1}^{N} v(k)}{\frac{1}{N}\sum_{k=1}^{N} i(k)}$$

Analisi degli studenti 2 e 3

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$$\hat{R}_{LS}(N) \xrightarrow[N \to]{} ?$$

converge!

Ma è polarizzato!

$$\hat{R}_{LS}(N) \xrightarrow[N \to \infty]{} \frac{\frac{1}{N}\sum_{k=1}^{N} E[v(k)] \cdot E[i(k)]}{\frac{1}{N}\sum_{k=1}^{N} E[i^2(k)]}$$

$$E[v(t)] = v_0 \qquad E[i(t)] = i_0$$

$$E[i^2(t)] = i_0^2 + \sigma_i^2$$

$$\mathrm{var}(x) = E[(x - E[x])^2]$$

$$= E[x^2] - \{E[x]\}^2$$

$$\hat{R}_{LS}(N) \xrightarrow[N\to\infty]{} \frac{v_0 i_0}{i_0^2 + \sigma_i^2} = \frac{R_0}{1 + \underbrace{\sigma_i^2 / i_0^2}_{\text{questo provoca il bias}}}$$

$$\hat{R}_{LS}(N) \xrightarrow[N\to\infty]{} \tilde{R} < R_0$$

$$\tilde{R} \xrightarrow[\sigma_i^2 \to 0]{} R_0$$

3

$$\hat{R}_{ML}(N) \xrightarrow[N \to \infty]{} \frac{E[v(k)]}{E[i(k)]} = \frac{v_0}{i_0} = R_0$$

stimatore non polarizzato