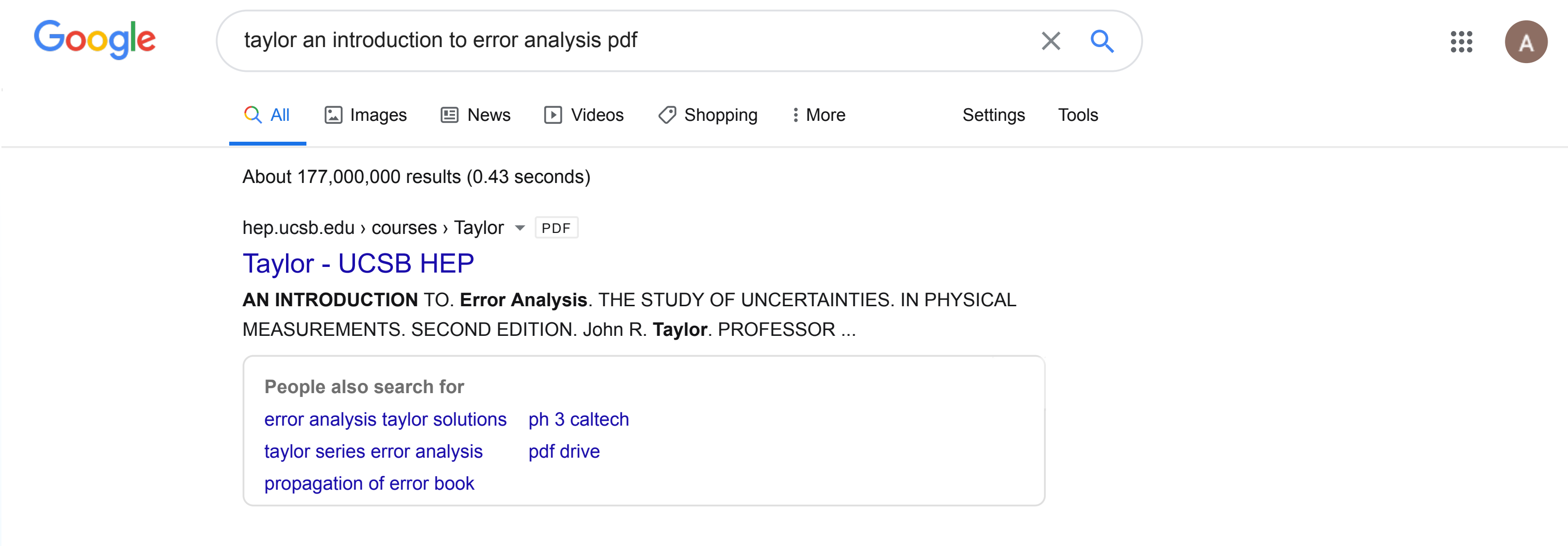
Link 30/04/2020

- Link alle due lezioni registrate:
  - https://drive.google.com/open?id=13tIZ3a40MAcepvfyYDAAWpkQuwh81YIu

Taylor

taylor an introduction to error analysis pdf - Google Search https://www.google.com/search?client=firefox-b-d&q=taylor+an+i...



30 Aprile 2020

$x_b \pm \delta x$ $\quad$ 10 ± 1

$y_b \pm \delta y$ $\quad$ 30 ± 2

CASUALE

$q = x + y$ $\quad$ $q_b = 40$ $\quad$ $\delta q = 1 + 2$ $\quad$ $\delta q = 2$

$$\delta q = \delta x \oplus \delta y = \sqrt{(\delta x)^2 + (\delta y)^2}$$

$$= \sqrt{1+4} = \sqrt{5} = 2$$

$q = x - y$ $\quad$ $q_b = -20$

$q = x \cdot y$ $\quad$ $q_b = 300$ $\quad$ δq $\quad$ $q_b = 300 \pm 40$

$$\frac{\delta q}{q_b} = \frac{\delta x}{x_b} \oplus \frac{\delta y}{y_b} = \sqrt{\left(\frac{\delta x}{x_b}\right)^2 + \left(\frac{\delta y}{y_b}\right)^2} =$$

$$= \sqrt{\left(\frac{1}{10}\right)^2 + \left(\frac{2}{30}\right)^2} = \sqrt{0.014}$$

0.01 $\quad$ 0.0044 $= 0.12$

$$\delta q = 0.12 \cdot q_b = 0.12 \cdot 300 = 36$$

$q = x/y \qquad q_b = \frac{10}{30} = \frac{1}{3} = 0.33$ (2)

$\left|\frac{\delta q}{q_b}\right| = 0.12 \qquad \delta q = 0.12 \cdot 0.33 = 0.04$

$q_b = 0.33 \pm 0.04$

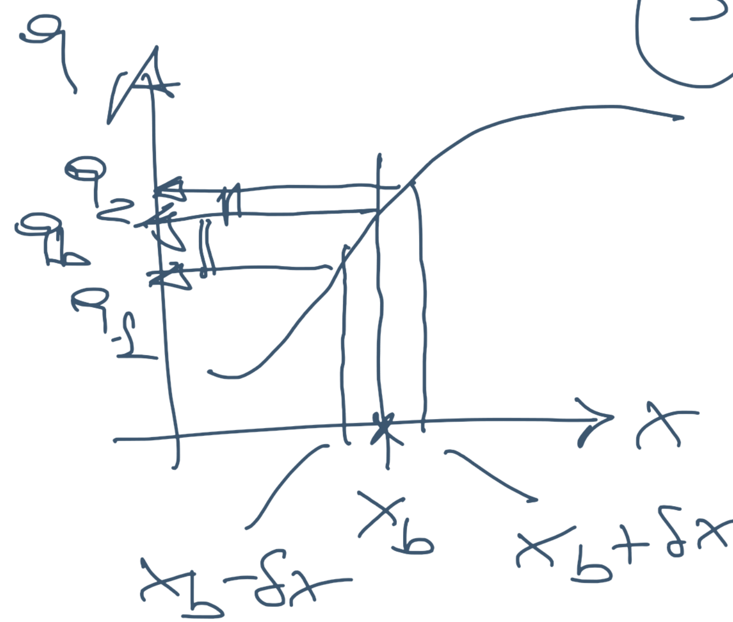
SOMME O SOTTRAZIONI

$\delta q = \delta x \oplus \delta y \oplus \delta z \oplus \delta w \ldots$

PRODOTTI O DIVISIONI $\qquad q = \frac{x \cdot y}{z \cdot w}$

$\frac{\delta q}{q} = \frac{\delta x}{x} \oplus \frac{\delta y}{y} \oplus \frac{\delta z}{z} \oplus \frac{\delta w}{w}$

FUNZIONI ARBITRARIE



$$q_b = q(x_b)$$

$$q(x_b+\delta x) = q_2$$

$$q(x_b-\delta x) = q_1$$

$$\delta q \simeq q_2 - q_b \sim q_b - q_1$$

$$\simeq q(x_b+\delta x) - q(x_b) \sim \left.\frac{dq}{dx}\right|_{x_b} \cdot \delta q$$

$$\delta q = \left|\frac{dq}{dx}\right|_{x_b} \cdot \delta x$$

$$\delta q = \sqrt{\left(\left.\frac{dq}{dx}\right|_{x_b} \cdot \delta x\right)^2 + \left(\left.\frac{dq}{dy}\right|_{y_b} \delta y\right)^2 + \dots}$$

$$q = \frac{x+y}{x+z}$$

$$q = x\,(y - z\sin\alpha)$$

$x_b \pm \delta x \quad z_b \pm \delta z$

$y_b \pm \delta y \quad \alpha_b \pm \delta\alpha$

$w = \sin\alpha$

$$\delta w = \left|\frac{dw}{d\alpha}\right|_{\alpha_b} \delta\alpha = |\cos\alpha_b| \cdot \delta\alpha$$

$w_b \pm \delta w$

$$q = x\,(y - z \cdot w)$$

$p = z \cdot w$

$$\frac{\delta p}{p_b} = \frac{\delta z}{z_b} \oplus \frac{\delta w}{w_b} \Longrightarrow \delta p$$

$p_b \pm \delta p$

$$q = x(y - p) \longrightarrow q = x \cdot r \qquad q_b = x_b \cdot r_b \qquad \frac{\delta q}{q_b} = \frac{\delta x}{x_b} \oplus \frac{\delta r}{r_b}$$

$r = y - p \qquad r_b = y_b - p_b$

$$\delta r = \delta y \oplus \delta p$$

$r_b \pm \delta r$

$$q = \frac{x+y}{x+z}$$

$$\begin{cases} \omega = x + y \\ \phi = x + z \end{cases} \qquad \omega_b,\ \delta\omega \qquad \phi_b,\ \delta\phi$$

$$q = \frac{\omega}{\phi} \qquad \frac{\delta q}{q} = \frac{\delta \omega}{\omega} \oplus \frac{\delta \phi}{\phi} \qquad \text{NO}$$

$$q = x\,(y - z \sin\alpha)$$

α, z, y, x

INDIPENDENT)

use ϕ ... INDIPENDENT? NO

$$\delta q = \sqrt{\left(\frac{dq}{dx}\right)^2_{x_b} \delta x^2 + \left(\frac{dq}{dy}\right)^2_{y_b} \delta y^2 + \left(\frac{dq}{dz}\right)_{z_b} \delta z^2}$$

CASUALI VS SISTEMATICHE

CRONOMETRO

1 ms

70,0 s
70,5 s
69,5 s

70,0 ± 0,5

CASUALI

70,0
70,5
71,2
71,0
70,5

70,5 ± 0,8

SCARICO

CASUALI (S) $N=5$ (7

		$\lvert D_i \rvert$	$\lvert D_i \rvert^2$
71	-1	$+1$	1
73	1	1	1
72	0	0	0
71	-1	1	1
73	1	1	1
	0	4	4

$$\sqrt{\frac{\sum (D_i)^2}{N}}$$

DEVIAZIONE STANDARD

$$\bar{x} = 72 = \frac{\sum_{i=1,N} x_i}{N}$$

DEVIAZIONE $x_i - \bar{x}$

$$\sum (x_i - \bar{x}) = \sum x_i - \sum \bar{x} = \sum x_i - \bar{x} N = \sum x_i - \frac{\sum x_i}{\cancel{N}} \cancel{N} = 0$$

$$\sigma_x = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{N-1}}$$

$$\sigma_x = \sqrt{\frac{4}{4}} = \sqrt{1} = 1$$

N misure $x_1, \dots, x_N$

$$\bar{x} = \frac{\sum_{i=1,N} x_i}{N} = \frac{\sum x_i}{N}$$

$$\sigma_x = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{N-1}}$$

$\bar{x} \pm \sigma_x$

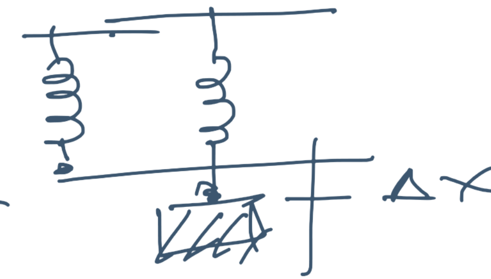
71	71 ± 1
73	73 ± 1
72	72 ± 1
73	73 ± 1
71	71 ± 1

$x_b = \bar{x}$

$$\sigma_{\bar{x}} = \sqrt{\frac{\sigma_x^2}{N}} = \sqrt{\frac{1}{5}} = \sqrt{0.2} = 0.4$$

$\sigma_b = 72{,}0 \pm 0{,}4$ s

MOLLE $F = -kx$ Hook(e)



k 86, 85, 84, 89, 86 $N\,m^{-1}$

$\bar{k}$ 85,9 N/m $\sigma_k = 1{,}9\ N\,m^{-1}$

$\sim 2\ N\,m^{-1}$

$N = 1_0$ (86 ± 2)

11 84, 88

MOLLA 1 $k_b = 86 \pm \frac{2}{\sqrt{b}}$ 0,6

$85{,}9 \pm 0{,}6\ N\,m^{-1}$

MOLLA 2 $k_2 = 72\ N\,m^{-1}$ $k_2 = (72 \pm 2)\ N\,m$

es. 4.7

11° misura della molla 1

$x_b = 72 \pm 2$

(6)

$$\sigma_x = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{N-1}}$$

$x_i \pm \sigma_x$

$\bar{x}$

$$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{N}} = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{N(N-1)}} = \frac{\sqrt{\sum_i (x_i-\bar{x})^2}}{N}$$

$N(N-1) \sim N^2$

$N \gg$ $\sigma_x \sim$ INVARIATO

$\sigma_{\bar{x}}$ MIGLIORA $\frac{1}{\sqrt{N}}$

$$\sum_i (x_i - \bar{x})^2 = \sum_i \delta^2 = N\delta^2$$

$$\sigma_x = \sqrt{\frac{N\delta^2}{N}} \sim \delta \qquad \sigma_{\bar{x}} = \frac{\delta}{\sqrt{N}}$$