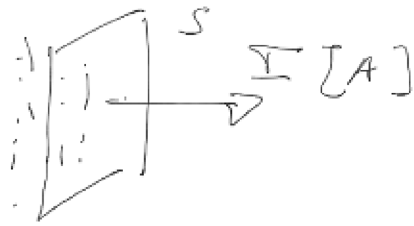
Lezione 2

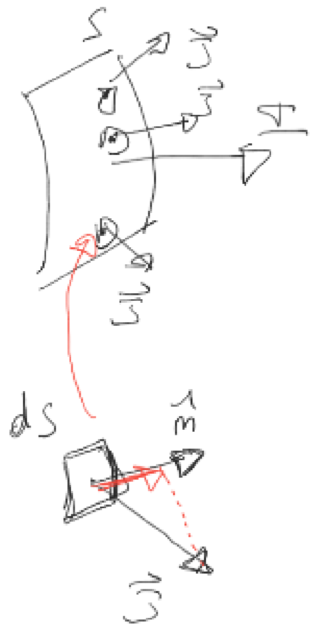
Dei campi ai circuiti



Maxwell

$$\boxed{\begin{aligned} \nabla \times \vec{E} &= -\frac{\partial \vec{B}}{\partial t} \\ \nabla \times \vec{H} &= \vec{J} + \frac{\partial \vec{D}}{\partial t} \end{aligned}}$$

$\vec{J}\ \left[\frac{A}{m^2}\right]$ densità di corrente



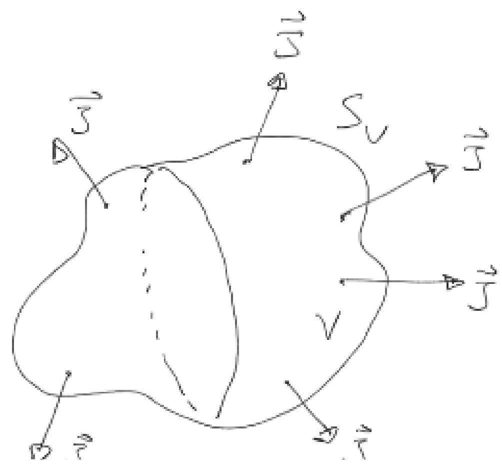
$$\underset{\text{corrente}}{I} = \int_S \vec{J}\,d\vec{S} = \int_S \vec{J}\cdot\underbrace{\hat{m}\,dS}_{d\vec{S}}$$

Condizione di stazionarietà: derivate temporali nulle

$$\boxed{\begin{aligned} \nabla \times \vec{E} &= \emptyset \\ \nabla \times \vec{H} &= \vec{J} \end{aligned}} \leftarrow$$

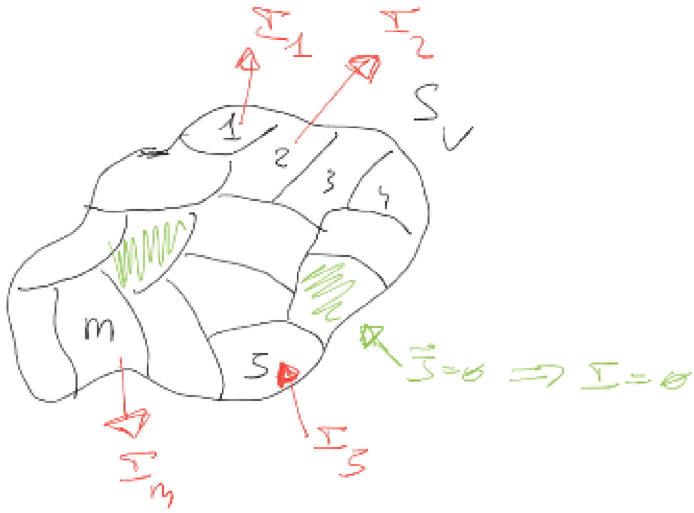
Teorema della divergenza (Gauss)

$$\int_{S_V} \vec{J}\cdot\hat{m}\,dS_V = \int_V \nabla\cdot\vec{J}\cdot dV$$



$$\oint_{S_V} \vec{J}\cdot\hat{n}\,dS_V = \int \nabla\cdot(\nabla\times H)\cdot dV = \emptyset$$

$$\boxed{\oint_{S_V} \vec{J}\cdot\hat{n}\,dS_V = \emptyset}$$

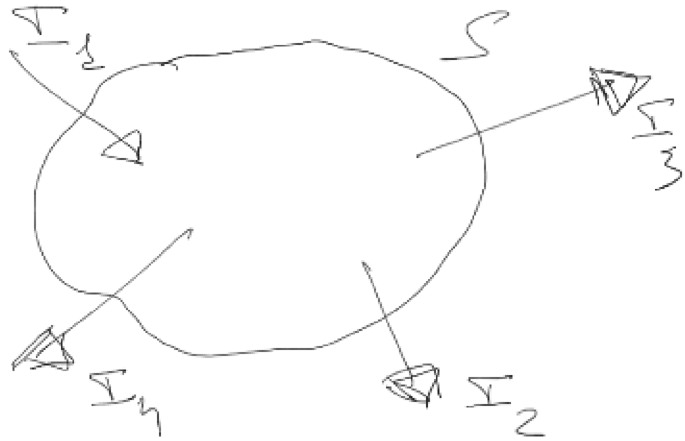


$$\oint_{S_V} \vec{J}\cdot\hat{n}\,dS_V = \sum_{i=1}^{m} \underbrace{\int_{S_{V_i}} \vec{J}\,\hat{n}\,dS_{V_i}}_{I_i} = \boxed{\sum_{i=1}^{m} I_i = \emptyset}$$

I corrente [A]

1° principio di KIRCHHOFF

Superficie CHIUSA



ENTRANTI +
USCENTI −

ENTRANTI −
USCENTI +

$$+I_1 - I_3 - I_4 - I_2 = \emptyset \iff -I_1 + I_3 + I_4 + I_2 = \emptyset$$

APPENDICE

GENERICO CAMPO VETTORIALE: $\vec{F}$

$$\nabla\cdot\vec{F} = \frac{\partial F_x}{\partial x} + \frac{\partial F_y}{\partial y} + \frac{\partial F_z}{\partial z} \qquad \vec{F} = (F_x, F_y, F_z)$$

$\partial x \qquad \partial y \qquad \partial z$ $\qquad\qquad F = (x, y, t)$

$F_x = f_x(x, y, z, t)$

$F_y = f_y(x, y, z, t)$

$F_z = f_z(x, y, z, t)$

DIVERGENZA DI F

$$\nabla \times \vec{F} = \begin{array}{c} \left(\dfrac{\partial F_z}{\partial y} - \dfrac{\partial F_y}{\partial z} , \dfrac{\partial F_x}{\partial z} - \dfrac{\partial F_z}{\partial x} , \dfrac{\partial F_y}{\partial x} - \dfrac{\partial F_x}{\partial y} \right) \\ i \qquad\qquad\qquad\qquad j \qquad\qquad\qquad\qquad k \end{array}$$

ROTORE DI $\vec{F}$

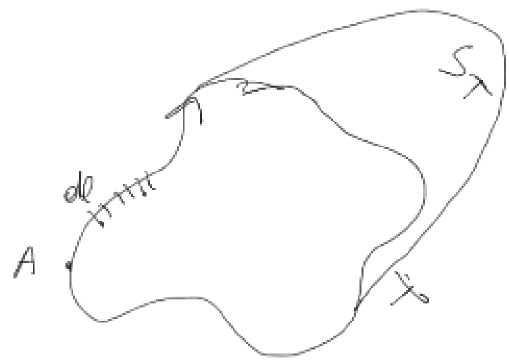
DERIVATA TEMPORALE DI UN CAMPO VETTORIALE

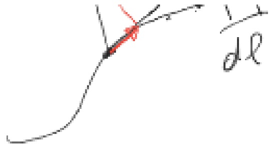
$$\frac{\partial \vec{F}}{\partial t} = \begin{array}{c} \left(\dfrac{\partial F_x}{\partial t} , \dfrac{\partial F_y}{\partial t} , \dfrac{\partial F_z}{\partial t} \right) \\ i \qquad\quad j \qquad\quad k \end{array}$$

$\nabla \times \vec{E} = \emptyset \Leftarrow$ IPOTESI DI STAZIONARIETÀ

TEOREMA DI KELVIN - STOKES

$$\oint_\gamma \vec{E} \cdot \hat{l}\, dl = \int_{S_\gamma} (\nabla \times \vec{E})\, \hat{n}\, dS_\gamma$$

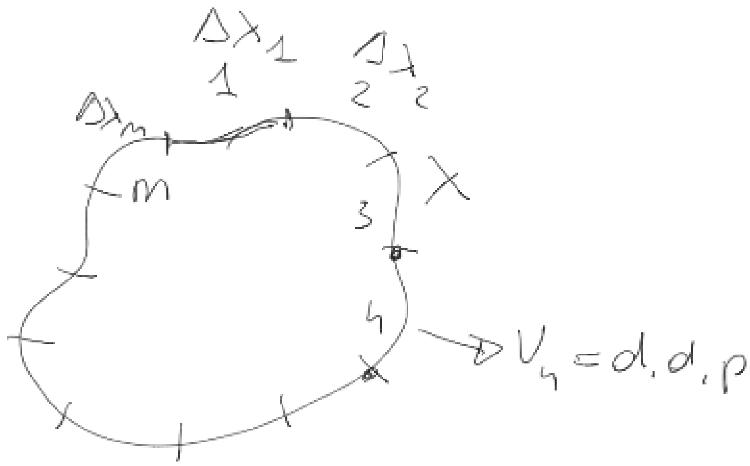




$$\boxed{\oint_{\lambda} \tilde{E}\cdot\hat{l}\,dl = \emptyset}$$

$E = \dfrac{F}{q}$ campo elettrico

$E \cdot dl = \dfrac{F \cdot dl}{q}$ LAVORO (ENERGIA)



$$\oint_{\lambda} \tilde{E}\cdot\hat{l}\,dl = \sum_{i=1}^{m} \int_{\Delta\lambda_i} \tilde{E}\cdot\hat{l}\,dl = \boxed{\sum_{i=1}^{m} V_i = \emptyset}$$

2° principio di Kirchhoff

V è la tensione [V] Volt

ovvero una differenza di potenziale (d.d.p)