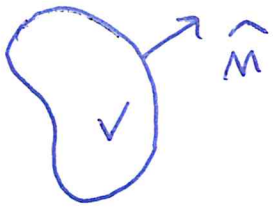
UNIVERSITA' DEGLI STUDI DI ROMA
SCUOLA DI INGEGNERIA AEROSPAZIALE
ISTITUTO DI PROPULSIONE AEROSPAZIALE

Roma, ...
00184 - Via Eudossiana, 18 - Tel. 483729

$$\int_0^L u' \, dx = u(L) - u(0)$$

$$\int_V \nabla \cdot u = \oint_{\partial V} u \cdot n \, dS$$

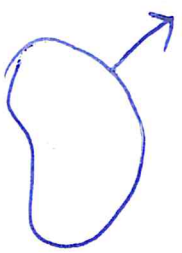


$$V = \int_{\Omega(t)} dV \Rightarrow \dot{V} = \frac{d}{dt} \int_{\Omega(t)} dV = \frac{d}{dt} \int_{\Omega_0} J \, dV_0$$

$$= \int_{\Omega_0} \nabla \cdot u \, |J| \, dV_0 = \int_{\Omega_0} \nabla \cdot u \, dV = \oint_{\partial \Omega_0} u \cdot n \, dS$$

$$V = \frac{4}{3} \pi R^3 \qquad \dot{V} = \underbrace{4 \pi R^2}_{S} \dot{R} \quad \uparrow v \text{ radiale}$$

$$dV = 4 \pi R^2 v \, dt$$



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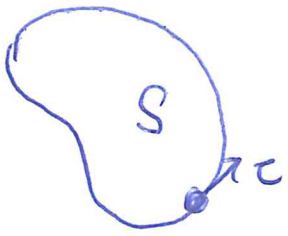


$$\int_{\partial S} u \cdot \tau \, dl = \int_S (\nabla \times u) \cdot n \, d\sigma \quad \Rightarrow \quad \frac{1}{S} \int \omega \cdot n \, dS = \bar{\omega}$$

$$\bar{\omega} = \frac{1}{S} \int_{\partial S} u \cdot \tau \, dl$$

$$\int_V \frac{\partial u_i}{\partial x_i} dV = \oint_{\partial V} u_i n_i$$

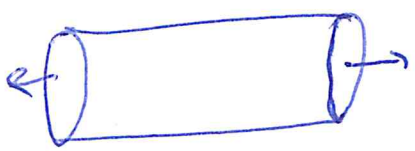
$$\nabla \cdot \phi I = \nabla \phi$$

$$\phi \delta_{ij} = \phi_{ij}$$

$$\int_V \frac{\partial T_{ij}}{\partial x_j} dV = \oint_{\partial V} T_{ij} n_j \, dV$$

$$\frac{\partial \phi_{ij}}{\partial x_j} = \frac{\partial \phi}{\partial x_j} \delta_{ij}$$

$$\int_V \frac{\partial \phi}{\partial x_i} dV = \oint_{\partial V} \phi n_i \, dS$$



$$\int \nabla p = \int_{\partial \Omega} p n \, dS + \int_{\partial \Omega^+} p n_i \, dy$$

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$$\int_V \nabla \times u \, dV = \oint_{\partial V} n \times u \, dS$$

$$\int_V \varepsilon_{ijk} \frac{\partial u_k}{\partial x_j} dV = \oint_{\partial V} \varepsilon_{ijk} u_k n_j \, dS$$

Karnak - Rep. San Marino

ES 5

$u = (S x_2, 0, 0) \qquad u_1 = S x_2 \quad u_2 = 0 \quad u_3 = 0$

MOTO PIANO

$$(\nabla u)_{ij} = \frac{\partial u_i}{\partial x_j} \Rightarrow \begin{cases} (\nabla u)_{11} = \dfrac{\partial u_1}{\partial x_1} = 0 & (\nabla u)_{21} = \dfrac{\partial u}{\partial x} \\ (\nabla u)_{12} = \dfrac{\partial u_1}{\partial x_2} = S & (\nabla u)_{22} = \dfrac{\partial u}{\partial} \end{cases}$$

$$\nabla u = \begin{bmatrix} 0 & S \\ 0 & 0 \end{bmatrix}$$

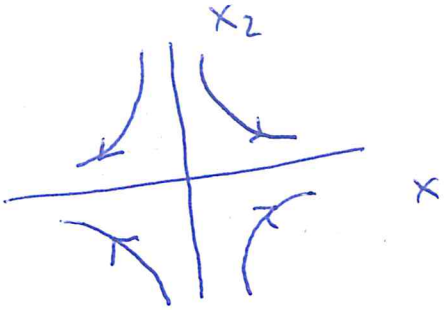
$$E_{ij} = \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) \Rightarrow \begin{cases} E_{11} = \dfrac{\partial u_1}{\partial x_1} = 0 & E_{12} = \dfrac{1}{2}\left(\dfrac{\partial u_1}{\partial x_2} + \right. \\ & = S/2 \\ E_{21} = \dfrac{1}{2}\left(\dfrac{\partial u_2}{\partial x_1} + \dfrac{\partial u_1}{\partial x_2}\right) = S/2 & E_{22} = \dfrac{\partial}{\partial} \end{cases}$$

$$E = \frac{1}{2}\left(\nabla u + \nabla u^T\right) = \begin{bmatrix} 0 & S/2 \\ S/2 & 0 \end{bmatrix}$$

$$\Omega_{ij} = \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} - \frac{\partial u_j}{\partial x_i}\right) \Rightarrow \begin{cases} \Omega_{11} = 0 & \Omega_{12} = \dfrac{1}{2}\left(\dfrac{\partial u_1}{\partial x_2} - \dfrac{\partial u_2}{\partial x_1}\right) = \\ \Omega_{21} = -S/2 & \Omega_{22} = 0 \end{cases}$$

$$\Omega = \frac{1}{2}\left(\nabla u - \nabla u^T\right) = \begin{bmatrix} 0 & S/2 \\ -S/2 & 0 \end{bmatrix}$$

$u = (a x_1, -a x_2, 0)$ CAMPO PIANO



$$(\nabla u)_{11} = \frac{\partial u_1}{\partial x_1} = a \qquad (\nabla u)_{21} = \frac{\partial u_2}{\partial x_1} = 0$$

$$(\nabla u)_{12} = \frac{\partial u_1}{\partial x_2} = 0 \qquad (\nabla u)_{22} = \frac{\partial u_2}{\partial x_2} = -a$$

$$\nabla u = \begin{bmatrix} a & 0 \\ 0 & -a \end{bmatrix} = E$$

$$E_{11} = \frac{\partial u_1}{\partial x_1} = a \qquad E_{12} = \frac{1}{2}\left(\frac{\partial u_1}{\partial x_2} + \frac{\partial u_2}{\partial x_1}\right) = 0$$

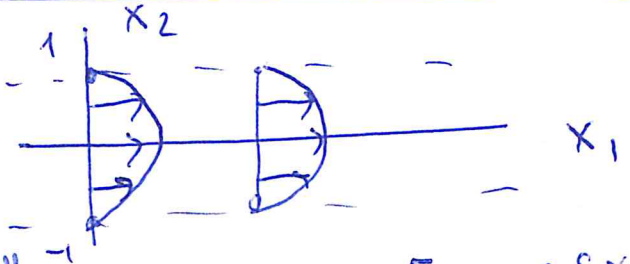
$$E_{21} = \frac{1}{2}\left(\frac{\partial u_2}{\partial x_1} + \frac{\partial u_1}{\partial x_2}\right) = 0 \qquad E_{22} = \frac{\partial u_2}{\partial x_2} = -a$$

$$\Omega_{11} = 0 \qquad \Omega_{12} = 0$$

$$\Omega = \nabla u - E = 0$$

$$\Omega_{21} = 0 \qquad \Omega_{22} = 0$$

$u = (S(x_2^2 - 1), 0)$



$$(\nabla u)_{11} = \frac{\partial u_1}{\partial x_1} = 0 \qquad (\nabla u)_{21} = \frac{\partial u_2}{\partial x_1} = 0$$

$$(\nabla u)_{12} = \frac{\partial u_1}{\partial x_2} = 2Sx_2 \qquad (\nabla u)_{22} = \frac{\partial u_2}{\partial x_2} = 0$$

$$\nabla u = \begin{bmatrix} 0 & 2Sx_2 \\ 0 & 0 \end{bmatrix}$$