Reynolds Transport Theorem

Engineering Fluid Mechanics

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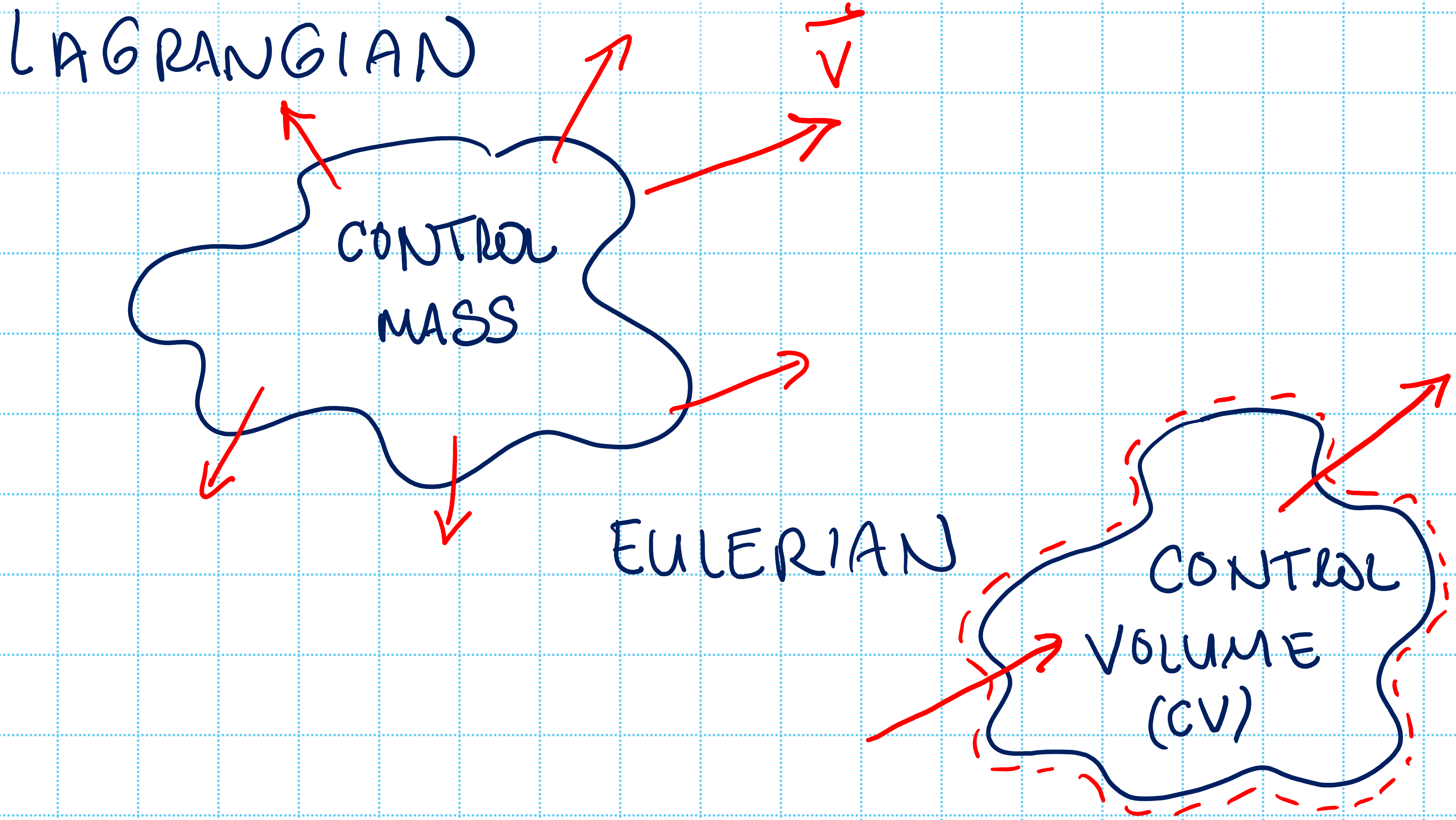

Lagrangian (systems) and Eulerian (control volume) analysis

$$\frac{dB_{sys}}{dt} = \frac{d}{dt}\int_{CV} \rho b \, dV + \int_{CS} \rho b \left(\vec{V_r} \cdot \hat{n}\right) dA$$

B = ANY <u>EXTENSIVE</u> PROPERTY OF A SYSTEM OF MASS

(MASS, ENERGY, MOMETUM)

b = THE CORRESPONDING <u>INTENSIVE</u> PROPERTY

$$\frac{B}{m} = b$$

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$$\frac{dB_{sys}}{dt} = \frac{d}{dt}\int_{CV} \rho b \, dV + \int_{CS} \rho b \, (\vec{V_r} \cdot \hat{n}) \, dA$$

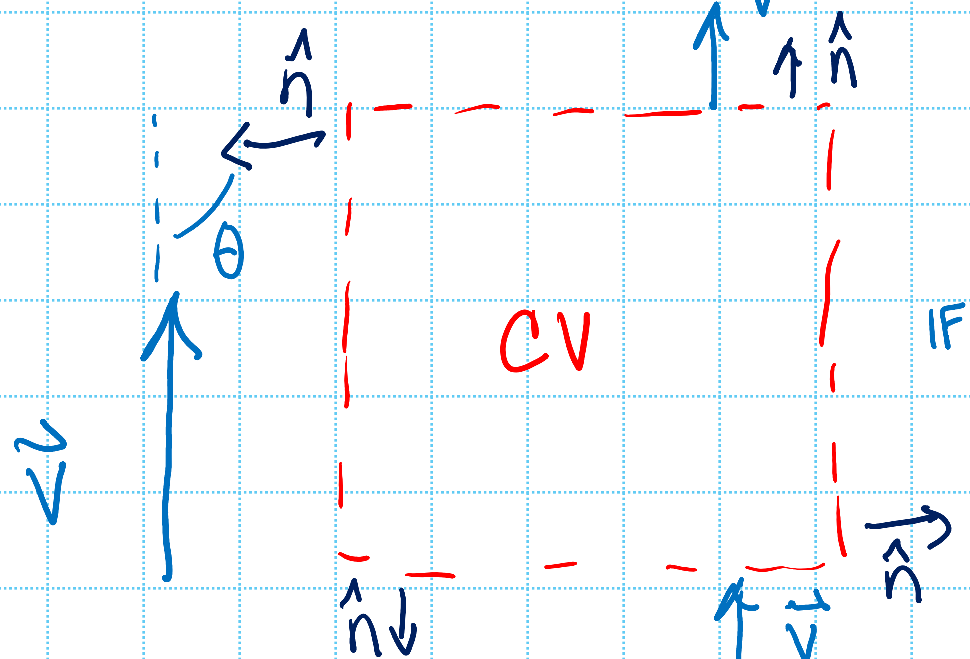
CHANGE OF B OVER TIME IN A SYSTEM OF MASS (IF B IS MASS, ENERGY, MOMENTUM WILL BE 0) = CHANGE MASS ENERGY, MOMENTUM IN CV OVER TIME + NET FLUX OF (MASS, ENERGY, MOMENTUM) OUT OF CV

Reynolds transport theorem

VELOCITY RELATIVE TO CS

$$\frac{dB_{sys}}{dt} = \frac{d}{dt}\int_{CV}\rho b \, dV + \int_{CS}\rho b \, (\vec{V}_r \cdot \hat{n}) \, dA$$

UNIT NORMAL VECTOR



$|V||n|\cos\theta$

IF $\theta = 90^\circ$
$\cos\theta = 0 \rightarrow$ NO FLUX

IF $\theta = 0^\circ$
$\cos\theta = 1 \rightarrow$ OUTFLUX

IF $\theta = 180^\circ$
$\cos\theta = -1 \rightarrow$ INFLUX

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THE END

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