Recap of lecture 10/31/2019

Conservation of linear momentum:

net force — rate of momentum change in fluid

$$\vec{F} = \int_{V(t)} \rho \frac{D\vec{v}}{Dt} dV$$

Net forces:

body forces — surface forces

$$\vec{F} = \int_{V(t)} \rho \vec{g}\, dV + \int_{S(t)} \vec{s}(\vec{n})\, dS$$

Stress Equilibrium:

stress vector at surface $\vec{n}$

at any point:

$$\lim_{S \to 0} \frac{1}{S} \int_{S(t)} \vec{s}(\vec{n})\, dS = 0$$

for control surfaces (special CV with two surfaces):

$$\lim_{S \to 0} \frac{1}{S} \left[\vec{s}(-n)\big|_1 S_1 + \vec{s}(n)\big|_2 S_2 \right] = 0$$

at any point:

$$s(\vec{n}) = -\vec{s}(-\vec{n})$$

Stress vector written for a specific coord. system $\{\vec{e}_i\}_{i=1,2,3}$

$$\vec{s}(\vec{n}) = \vec{n} \cdot \sum_i \vec{e}_i\, \vec{s}(\vec{e}_i) = \vec{n} \cdot \underline{\underline{\sigma}}$$