

Momentum budget

$$\frac{d}{dt} \int_{\mathcal{V}(t)} \rho \mathbf{u} d\mathcal{V} = \int_{\mathcal{V}(t)} \rho \mathbf{f} d\mathcal{V} + \int_{\mathcal{A}(t)} \boldsymbol{\tau} \cdot \mathbf{n} d\mathcal{A}$$

$$\int_{\mathcal{V}(t)} \rho \frac{D\mathbf{u}}{Dt} d\mathcal{V} = \int_{\mathcal{V}(t)} \rho \mathbf{f} d\mathcal{V} + \int_{\mathcal{A}(t)} \nabla \cdot \boldsymbol{\tau} d\mathcal{V}$$

$$\rho \frac{D\mathbf{u}}{Dt} = \rho \mathbf{f} + \nabla \cdot \boldsymbol{\tau}$$

$$\frac{\partial}{\partial t} (\rho \mathbf{u}) + \nabla \cdot (\rho \mathbf{u} \mathbf{u}) = \rho \mathbf{f} + \nabla \cdot \boldsymbol{\tau}$$