Therefore,

\[
\left( \frac{dF}{dB} \right)_x + \left( \frac{dF}{fs} \right)_x = m \left( \frac{a_p}{c} \right)_x
\]

\[
g \int dxdydz \left( f \right)_{B,x} + \left( \frac{\partial U_x}{\partial x} + \frac{\partial U_y}{\partial y} + \frac{\partial U_z}{\partial z} \right) dxdydz
\]

\[
= g \int dxdydz \left[ \frac{\partial U_x}{\partial t} + (\vec{V} \cdot \nabla) U_x \right]
\]

\[
\int dxdydz \left( f \right)_{B,x} + \left( \frac{\partial U_x}{\partial x} + \frac{\partial U_y}{\partial y} + \frac{\partial U_z}{\partial z} \right) = g \left[ \frac{\partial U_x}{\partial t} + (\vec{V} \cdot \nabla) U_x \right]
\]
See chapter 2, figure 2.6 (rotation of stress)

See chapter 5, figure 5.9 (stresses in x-direction)

We have shown that the net surface force in the x-direction is

\[
\left( \frac{dF}{dx} \right) = \frac{\partial F_x}{\partial x} \, dx \, dy \, dz + \frac{\partial F_y}{\partial y} \, dx \, dy \, dz + \frac{\partial F_z}{\partial z} \, dx \, dy \, dz
\]
Consider a differential fluid element $dx, dy, dz$

Let $\vec{f} = \text{body force per unit mass}$

Interested in net force acting on fluid element

$$\sum \vec{dF} = \vec{dF}_B + \vec{dF}_s$$

Body force

Surface force

$$d\vec{F}_B = g \, dx \, dy \, dz \, \vec{f}$$
Homework #6 due next Thursday — no class on Tuesday

Last time, we showed

\[ \sum \vec{F} = m \frac{\vec{a}}{p} \]

\[ \vec{a}_p = \frac{\vec{\Delta V}}{\Delta t} + (\vec{V} \cdot \nabla) \vec{V} \]

where \( \vec{V} \) is the velocity field.