EOS 352 Continuum Dynamics
Conservation law summary

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Overview

These notes cover the following

- Conservation of mass, momentum, angular momentum and energy in subscript notation

A summary of conservation laws

Below, ρ is ordinary mass density, c is heat capacity, u_i is the velocity field and σ_{ij} the stress field. f_i is body force, and a is rate of heat production per unit volume, and k thermal conductivity. Conservation of mass can be written as

$$\frac{\partial \rho}{\partial t} + \frac{\partial (\rho u_i)}{\partial x_i} = 0 \tag{1}$$

Conservation of linear momentum is

$$\rho \frac{\partial u_i}{\partial t} + \rho u_j \frac{\partial u_i}{\partial x_j} = \frac{\partial \sigma_{ij}}{\partial x_j} + f_i \tag{2}$$

while conservation of angular momentum requires

$$\sigma_{ij} = \sigma_{ji}. \tag{3}$$

We also derived the heat equation in the form

$$\rho c \frac{\partial T}{\partial t} + \rho c u_i \frac{\partial T}{\partial x_i} - \frac{\partial}{\partial x_i}\left(k \frac{\partial T}{\partial x_i}\right) = a. \tag{4}$$