Fluid Mechanics YouTube

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Part I
Navier Stokes Equations

Compressible N-S equations

$$\frac{\partial}{\partial t}(\rho\vec{u}) + \nabla \bullet (\rho\vec{u} \otimes \vec{u}) = -\nabla p + \mu\nabla^2\vec{u} + \frac{1}{3}\mu\nabla(\nabla \bullet \vec{u}) + \rho\vec{g}$$

tensor or outer product:

$$\vec{u} \otimes \vec{v} = \vec{u}\vec{v}^T$$

$$\vec{u} = \begin{pmatrix} u_1 \\ u_2 \\ u_3 \end{pmatrix} \; and \; \vec{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$$

$$\begin{pmatrix} u_1 \\ u_2 \\ u_3 \end{pmatrix} \otimes \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} = \begin{pmatrix} u_1 \\ u_2 \\ u_3 \end{pmatrix} \begin{pmatrix} v_1 & v_2 & v_3 \end{pmatrix}$$

$$= \begin{pmatrix} u_1v_1 & u_1v_2 & u_1v_3 \\ u_2v_1 & u_2v_2 & u_2v_3 \\ u_3v_1 & u_3v_2 & u_3v_3 \end{pmatrix}$$

Inner product

$$\vec{u} \bullet \vec{v} = \vec{u}^T\vec{v}$$

$$\begin{pmatrix} u_1 \\ u_2 \\ u_3 \end{pmatrix} \bullet \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} = \begin{pmatrix} u_1 & u_2 & u_3 \end{pmatrix} \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$$

$$= u_1 v_1 + u_2 v_2 + u_3 v_3$$

Assume incompressible flow:

$$\rho = constant$$

continuity equation

$$\nabla \bullet \vec{u} = 0$$

Incompressible N-S equations

$$\frac{\partial}{\partial t}\vec{u} + (\vec{u} \bullet \nabla)\vec{u} - \nu \nabla^2 \vec{u} = -\nabla \frac{P}{\rho_0} + \vec{g}$$

`https://en.wikipedia.org/wiki/Navier%E2%80%93Stokes_equations`

`Matrices in LaTeX`
`https://www.overleaf.com/learn/latex/Matrices`

`Tensors in LaTeX`

Part II
Boundary Layer Equations

1 Resources Online

`http://web.mit.edu/fluids-modules/www/highspeed_flows/ver2/bl_Chap2.pdf`
`https://community.dur.ac.uk/suzanne.fielding/teaching/BLT/sec3.pdf`

Part III
Github Repo

`https://github.com/theodoreOnzGit/heatTransferTheory_YouTube`

Look under convection heat transfer...