

September 10, 2014

Fluid dynamics

Problem 1 (10 points)

Let us consider the following flow field:

$$\mathbf{u} = (u, v, w), \quad u = 0.5 + 0.8x, \quad v = 1.5 - 0.8y, \quad w = 0,$$

where u , v and w are the x , y and z components of the velocity, respectively.

- Is the flow steady?
- Is the flow incompressible?
- Is the flow two-dimensional?
- Compute the components of the rate of deformation tensor and of the rotation tensor.
- A stagnation point is defined as a point in the flow field where the velocity is identically zero. Determine if there are any stagnation points in this flow field and, if so, where?

Theoretical question 1 (10 points)

Derive the equation governing the pressure distribution in an fluid at rest acted on by a body force field \mathbf{f} . Solve it assuming that:

- the fluid is incompressible ($\rho = \text{const}$),
- the body force field is gravity, $\mathbf{f} = (0, 0, -g)$.

Theoretical question 2 (10 points)

Derive the continuity equation.