Navier-Stokes Equations

$$\frac{\partial \rho}{\partial t} + \mathbf{\nabla} \cdot \rho \vec{U} = 0$$

$$\frac{\partial \rho \vec{U}}{\partial t} + \mathbf{\nabla} \cdot \rho \vec{U} \times \vec{U} + \mathbf{\nabla} \cdot (\tau - PI) = 0$$

$$\frac{\partial \rho e}{\partial t} + \mathbf{\nabla} \cdot (\rho e + P)\vec{U} - \mathbf{\nabla} \cdot \tau \vec{U} - \mathbf{\nabla} \cdot k \mathbf{\nabla} T = 0$$

$$P = \rho R T$$

$$e = \frac{R}{\gamma - 1} T$$

$$\mu = \mu_0 \frac{T_0 + C}{T + C} (\frac{T}{T_0})^{\frac{3}{2}}$$

$$k = \frac{\gamma R \mu}{P_r(\gamma - 1)}$$

Definitions

$$\vec{U} = \begin{bmatrix} u \\ v \\ w \end{bmatrix}$$

ρ - density [kg/m^3]

u, v, w - velocity in x, y, z in Cartesian coordinates [m/s]

P - pressure [Pa]

e - internal energy [J/kg]

k - thermal conductivity [$\frac{W}{m \cdot k}$]

T - temperature [K]

τ - viscous stress tensor

μ - dynamic viscosity [$\frac{N \cdot s}{m^2}$]