Acceleration Vector

Engineering Fluid Mechanics

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$$\vec{V}(\vec{D}, t) = \frac{d}{dt}\left(\vec{D}(t)\right)$$

$$\vec{V}(\vec{D}, t) = u\hat{i} + v\hat{j} + w\hat{k}$$

$$u: V_x, \frac{dx}{dt} \qquad v: V_y, \frac{dy}{dt} \qquad w: V_z, \frac{dz}{dt}$$

$$\vec{a}(\vec{D}, t) = \frac{d}{dt}\left(\vec{V}(\vec{D}, t)\right)$$

Acceleration Vector

Acceleration Vector

$$\vec{a}(\vec{D}, t) = \frac{d\vec{V}}{dt} + \frac{\partial \vec{V}}{\partial x}\frac{\partial x}{\partial t} + \frac{\partial \vec{V}}{\partial y}\frac{\partial y}{\partial t} + \frac{\partial \vec{V}}{\partial z}\frac{\partial z}{\partial t}$$

$\frac{\partial x}{\partial t} \rightarrow u$, $\frac{\partial y}{\partial t} \rightarrow v$, $\frac{\partial z}{\partial t} \rightarrow w$

$$\vec{a} = \frac{d\vec{V}}{dt} + u\frac{\partial \vec{V}}{\partial x} + v\frac{\partial \vec{V}}{\partial y} + w\frac{\partial \vec{V}}{\partial z}$$

LOCAL ACCELERATION
FUNCTION OF TIME

CONVECTIVE ACCELERATION
FUNCTION OF SPACE

$$\vec{a} = \frac{D\vec{V}}{Dt}$$

MATERIAL DERIVATIVE

$$\vec{a} = \frac{\partial \vec{V}}{\partial t} + (\vec{V}\cdot\vec{\nabla})\vec{V}$$

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