Mathematics

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5.1 Kinematics

5.1.1 Coordinates

Lagrangian $\underline{x}(\underline{a}, t)$: The motion of individual particles is studied; the position $\underline{x}$ of a particle at time t is related to its position at a reference point in time $\underline{a}$ (typically at $t = 0$).

Eulerian $(\underline{x}, t)$: The state of a fluid is described in terms of the values at a fixed location $\underline{x}$ and at fixed time t

5.1.2 Velocity

In Cartesian coordinates the velocity of a fluid particle at position $\underline{x}(x, y, z)$ is given by:

$$\underline{u}(x, y, z) = u(x, y, z)\hat{\underline{i}} + v(x, y, z)\hat{\underline{j}} + w(x, y, z)\hat{\underline{k}}$$