Lecture 15 - example calculation of acceleration

$$\underline{v} = \begin{bmatrix} v_x \\ v_y \end{bmatrix} = \begin{bmatrix} 3x + 4\cos t \\ -3y + 7x + 4\sin t \end{bmatrix}$$

* What is the local acceleration?
* What is the convective acceleration?
* What is the total acceleration?

$$\frac{\partial v_x}{\partial t} = -4\sin t$$

$$\frac{\partial v_y}{\partial t} = 4\cos t$$

$$\underline{a}_{local} = \begin{bmatrix} -4\sin t \\ 4\cos t \end{bmatrix}$$

$$\underline{v}\cdot\nabla\underline{v} = v_x \cdot \frac{\partial \underline{v}}{\partial x} + v_y \cdot \frac{\partial \underline{v}}{\partial y}$$

$$\frac{\partial \underline{v}}{\partial x} = \begin{bmatrix} 3 \\ 7 \end{bmatrix} \qquad \frac{\partial \underline{v}}{\partial y} = \begin{bmatrix} 0 \\ -3 \end{bmatrix}$$

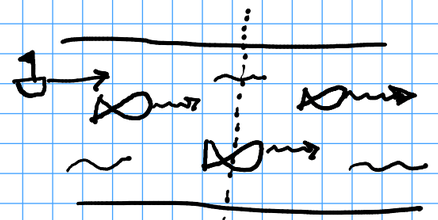
$$v_x \frac{\partial \underline{v}}{\partial x} = \begin{bmatrix} (3x + 4\cos t)\,3 \\ (3x + 4\cos t)\,7 \end{bmatrix}$$

$$v_y \frac{\partial \underline{v}}{\partial y} = \begin{bmatrix} (-3y + 7x + 4\sin t)\cdot 0 \\ (-3y + 7x + 4\sin t)\,(-3) \end{bmatrix}$$

$$\underline{a}_{conv} = \begin{bmatrix} 9x + 12\cos t \\ 0x + 9y + 28\cos t - 12\sin t \end{bmatrix}$$

$$\underline{a}_{total} = \frac{\partial \underline{v}}{\partial t} + \underline{v}\cdot\nabla\underline{v} = \frac{D\underline{v}}{Dt}$$

$$\underline{a}_{total} = \begin{bmatrix} 9x + 12\cos t - 4\sin t \\ 9y + 32\cos t - 12\sin t \end{bmatrix}$$



Lagrangian $\frac{\Delta f}{\Delta t} + \frac{\Delta x}{\Delta t}\frac{\Delta f}{\Delta x}$ (conv. acceleration) $= \frac{\Delta f}{\Delta t}$ (total acceleration) − local Eulerian