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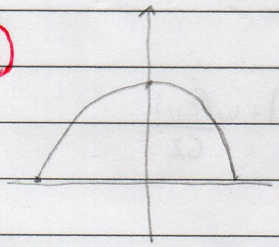
3ª lista de mecânica dos fluidos

4.2, ~~4.3~~, ~~4.17~~, ~~4.18~~, 4.52, ~~4.20~~.

4.8



P/ x=0, temos que

$u_{ent} = a + b(x+c)^2$ ~~^{0}~~

$u_{ent} = a$

P/ x=L temos c=0 (para conseguir obedecer a condição de contorno)

$u = a + b(x+c)^2$

$u_{saida} = a + b x^2$; substituindo

sempre c=0

$u_{saida} = u_{ent} + b \cdot L^2$

$b = \frac{u_{saida} - u_{entrada}}{L^2}$

Aplicando na equação, temos:

$u = u_{ent} + \frac{u_{saida} - u_{entrada}}{L^2} \cdot y^2$

Encontrando o ponto de estagnação igualo-se as coordenadas a zero.

4.3 $\vec{V} = (u,v) = (0,5 + 1,2x)\hat{i} + (-2,0 - 1,2y)\hat{j}$

$u = (0,5+1,2x)i = 0 \Rightarrow x = -\frac{0,5}{1,2} \Rightarrow x = -0,4166$

$v = (-2,0 - 1,2y)j = 0 \quad y = \frac{-2,0}{1,2} \Rightarrow y = -1,666$

V(u,v)

4.17 $u = 1,1 + 2,8x + 0,65y$ } Campo de velocidade $\vec{V} = (u,v)$

$v = 0,98 - 2,1x - 2,8y$ }

$\vec{a}_x = \frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}$

$\vec{a}_y = \frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial u}{\partial z}$ } Campo de aceleração

$\vec{a}_x = 0 + (1,1 + 2,8x + 0,65y)(2,8) + (0,98 - 2,1x - 2,8y)(0,65) + 0$

$= 3,08 + 7,84x + 1,82y + 0,637 - 1365x - 1,82y$

$\vec{a}_y = 0 + (1,1 + 2,8x + 0,65y)(-2,1) + (0,98 - 2,1x - 2,8y)(-2,8)$

$-2,31 - 5,88x - 1,365y - 2,744 + 5,188x + 7,84y$

P/ (x,y) = (-2,3) temos

$a_x = -9,233$

$a_y = 14,37$.

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4.18 - $u = 0,2 + 1,3x + 0,85y$ $\left.\right\}$ $\vec{V} = (x,y)$ campo de velocidade

$V = -0,50 + 0,95x - 1,3y$ $\left.\right\}$

Campo de aceleração

$$a_x = \frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z} \qquad a_y = \frac{\partial v}{\partial t} + u\frac{\partial (v)}{\partial x} + v\frac{\partial (v)}{\partial y} + w\frac{\partial (v)}{\partial z}$$

$a_x = 0 + (0,2 + 1,3x + 0,85y)(1,3) + (-0,5 + 0,95x - 1,3y)(0,85) + 0$

$= 0 + 0,26 + 1,69x + 1,105y - 0,425 + 0,8075x - 1,105y + 0$

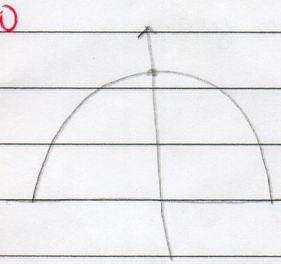
P/(2,2) $a_x = 2,33$

$a_y = 0 + (0,2 + 1,3x + 0,85y)(0,95) + (-0,5 + 0,95x - 1,3y)(-1,3) + 0$

$= 0 + 0,19 + 1,235x + 0,8075y + 0,65 - 1,235x + 1,69y + 0$

P/(2,2) $a_y = 5,835$

4.20



para que as condições de contorno

$x=0$; $u = u_{ent}$ e $x=1$, $u = u_{saída}$; temos que $c=0$

$u = a + b(x+c)^2$, logo, como $c=0$ temos

$u = a + bx^2$

$u_{ent} = a + bx^{2^{=0}}$

$u_{ent} = a$

$u_{saída} = u_{ent} + b.l^2$

$$b = \frac{u_{saída} - u_{ent}}{l^2}$$

Logo $u = u_{ent} + \frac{u_{saída} - u_{ent}}{l^2}.x^2$

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4.32. $\vec{V}=(u,v)=(0,5+1,2x)\vec{i}+(-2,0-1,2y)\vec{j}$

$$\frac{dx}{u}=\frac{dx}{v}=\frac{dy}{v}=\frac{dz}{w}$$

$$\frac{dx}{u}=\frac{dx}{0,5+1,2x}=\frac{dy}{-2}\Rightarrow\int\frac{dx}{\underbrace{0,5+1,2x}_{u}}=\int\frac{dy}{-2-1,2y}$$

$$\frac{1}{1,2}\cdot\ln|u|+C=-\frac{1}{1,2}\cdot\ln|v|+C \qquad u=0,5+1,2x$$

$$du=1,2\,dx$$

$$\frac{1}{1,2}\ln|0,5+1,2x|=-\frac{1}{1,2}\ln|-2-1,2y|+C \qquad dx=\frac{du}{1,2}$$

$$-\ln|-2-1,2y|+C=\ln|0,5+1,2x|+C$$

$$\ln|0,5+1,2x|+\ln|-2-1,2y|+C$$

$$-C$$

$$C=\ln|0,5+1,2x|+\ln|-2-1,2y|$$

De acordo com a propriedade dos logaritmos temos

$$\ln\left[(0,5+1,2x)\cdot(-2-1,2y)\right]=C$$

aplicando e

$$e^{(0,5+1,2x)\cdot(-2-1,2y)}=e^{-C}$$

$$(0,5+1,2x)(-2-1,2y)=-C$$

$$-1,2y=\frac{-C}{(0,5+1,2x)}+2$$

$$y=\frac{C}{1,2(0,5+1,2x)}-\frac{2}{1,2}$$

spiral