ov3

October 10, 2022

1 Øving 3

1.1 Navier Stokes og flythastighet

1.1.1 0) LHS Navier = 0

$$\frac{\partial \vec{v}}{\partial t} + (\vec{v} \cdot \nabla)\vec{v} = -\frac{1}{\rho}\nabla p + \nu \nabla^2 \vec{v}$$

Gradienten til $\vec{v}$ er

$$\nabla \vec{v} = \frac{\partial v_r}{\partial r} + \frac{1}{r}\frac{\partial v_\phi}{\partial \phi} + \frac{\partial v_x}{\partial x}$$

fordi $\vec{v} = \hat{x} v_x$ har vi at

$$\nabla \vec{v} = \frac{\partial v_x}{\partial x}$$

Dette må være lik 0 fordi det ikke kan oppstå væske i kanalen.

Tidsavhengigheten til $\vec{v}$, $\frac{\partial \vec{v}}{\partial t}$ er 0 fordi vi har konstant flyt. Dermed blir hele det 2. leddet likt 0.

1.1.2 1) Grensebetingelser:

$$v(d/2) = 0$$

$$v(0) = v_{max}$$

1.1.3 2) Gjennomsnittlig flythastighet

$$< v >_r = \frac{\int_0^{d/2} \int_0^{2\pi} v(r) r \cdot d\theta dr}{\int_0^{d/2} \int_0^{2\pi} r \cdot d\theta dr}$$

$$= \frac{2\pi}{\pi (d/2)^2} \int_0^{d/2} v(r) r dr$$

Hastighetsprofilen er

$$v(r) = -\frac{\Delta p}{\eta l}\left(\frac{r^2}{4} - C_1 \ln r + C_2\right)$$

$$= \frac{\Delta p}{4\eta l}\left(\frac{d^2}{4} - r^2\right)$$

Gjennomsnittlig fart ender da opp med å være

$$< v >_r = \frac{\Delta p d^2}{32\eta l}$$

1.1.4 3) Volumetrisk væskestrøm

$$Q =< v >_r \cdot tverrsnitt =< v >_r \pi(d/2)^2$$

$$= \frac{\Delta p d^4}{128\eta l}$$

1.1.5 4) Snitt- vs maxfart

$$v_{max} = \frac{\Delta p d^2}{16\eta l}$$

$$< v >_r = \frac{\Delta p d^2}{32\eta l}$$

Vi kan se at maksfarten er dobbelt så stor som snittfarten

2 Random Walk

[2]:
```python
import numpy as np
import matplotlib.pyplot as plt
```

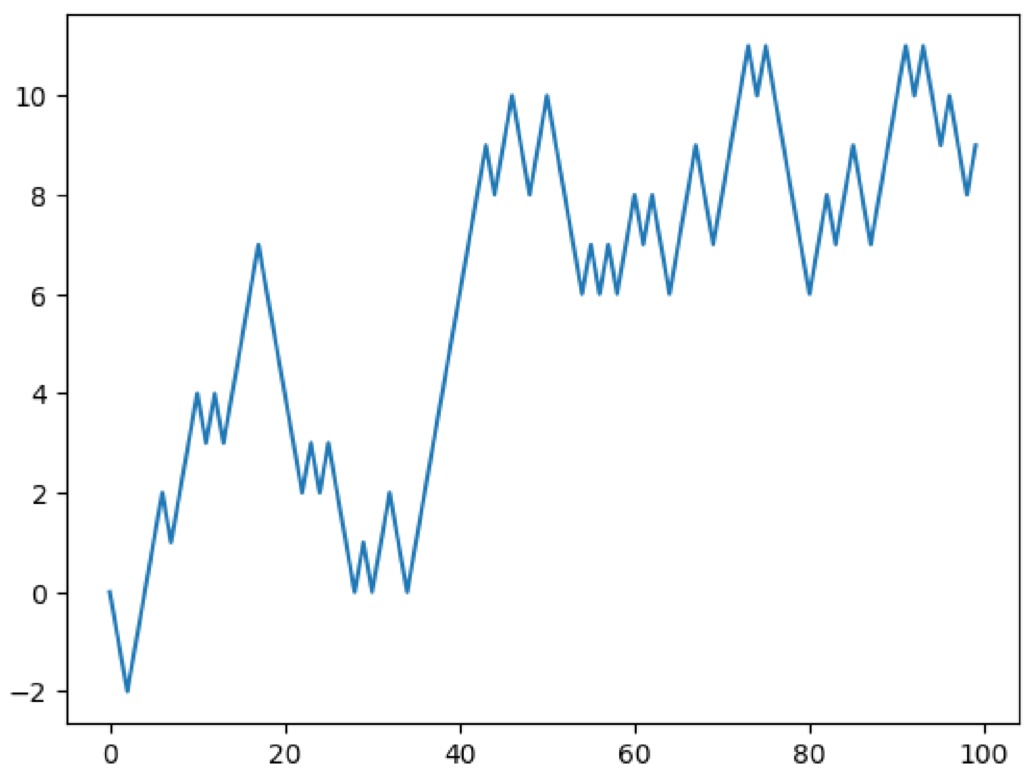
[206]:
```python
def walk_1d_1man(*, num_steps = 100, len_step = 1):
    sums = np.zeros(num_steps)
    steps = np.random.choice([-len_step, len_step], size=num_steps)
    for i in range(1, num_steps):
        sums[i:] += steps[i]
    plt.plot(sums)

def walk_1d_many(*, num_steps = 100, num_walks = 150, len_step = 1):
    walkers = np.zeros((num_steps, num_walks))
    steps = np.random.choice([-len_step, len_step], size=(num_steps, num_walks))
    for i in range(1, num_steps):
        walkers[i:] += steps[i]
    plt.hist(walkers[-1])
```

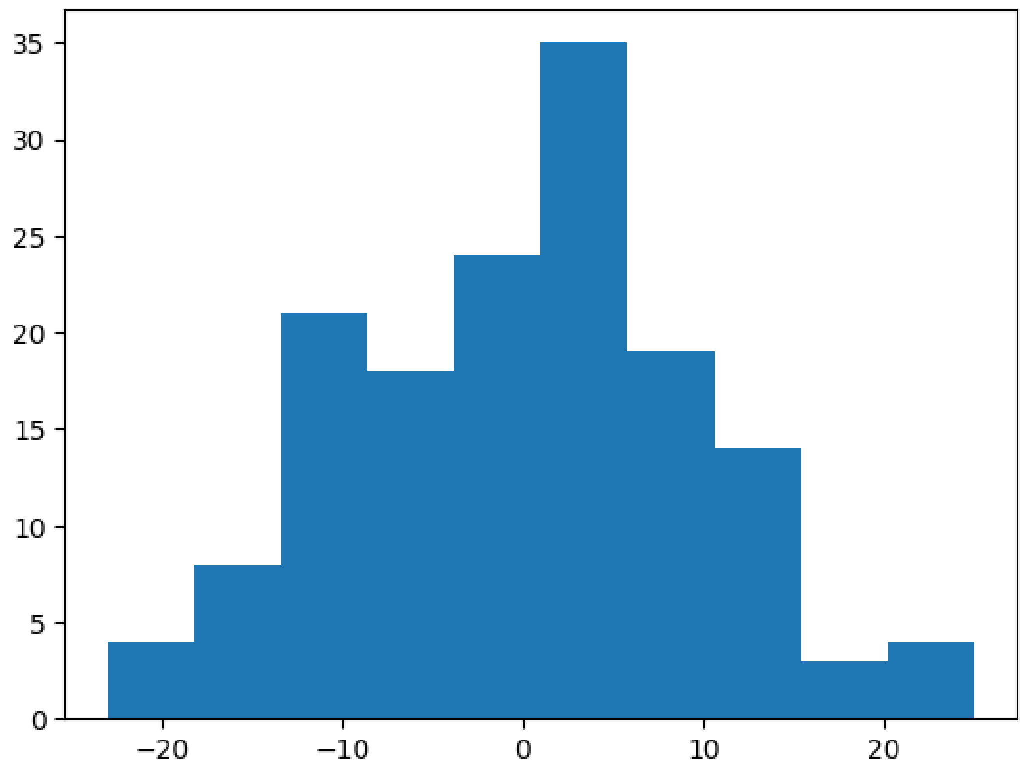
```
def walk_1d_many_compare(*, num_steps = 100, num_walks = 150, len_step = 1):
    walkers = np.zeros((num_steps, num_walks))
    steps = np.random.choice([-len_step, len_step], size=(num_steps, num_walks))
    for i in range(1, num_steps):
        walkers[i:] += steps[i]
    avg_dist = np.sum(walkers[-1])/num_walks
    mean_squared_disp = np.sum(walkers[-1]**2)/num_walks
    print(f"{avg_dist=}")
    print(f"{mean_squared_disp=}")

    ## Fasit
    avg_dist_fasit = 0
    mean_squared_disp_fasit = num_steps * len_step**2
    print(f"{avg_dist_fasit=}")
    print(f"{mean_squared_disp_fasit=}")
```

[207]:
```
walk_1d_1man()
```



[208]:
```
walk_1d_many()
```



[209]:
```
walk_1d_many_compare(num_steps=100, num_walks=500, len_step=5)
```

```
avg_dist=-0.2
mean_squared_disp=2597.0
avg_dist_fasit=0
mean_squared_disp_fasit=2500
```