calculation

November 18, 2023

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

[2]:
```
df = pd.read_excel('data.xlsx')
print(df.head())
```

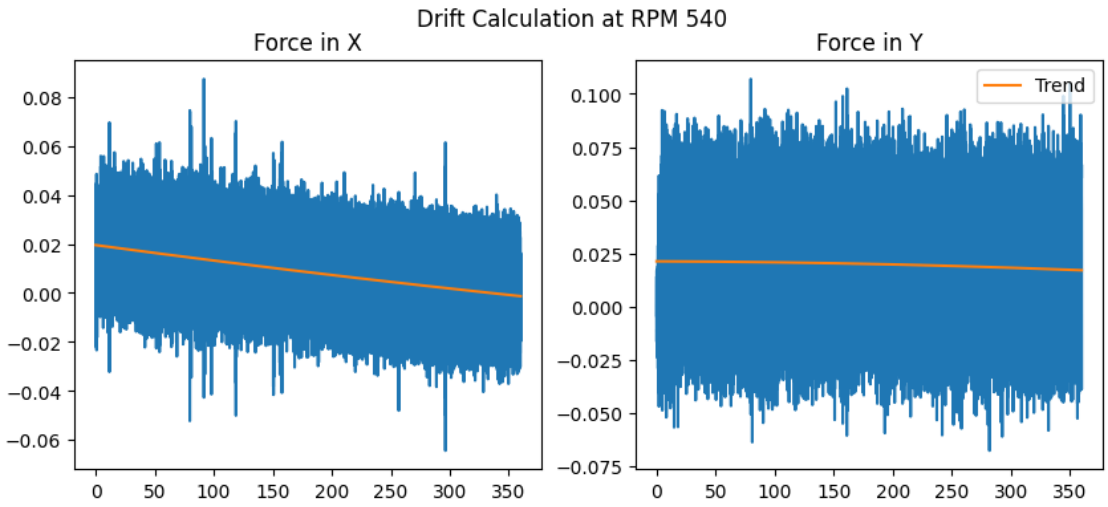
```
   T_540_0   X_540_0   Y_540_0      T   X_540_2   Y_540_2   X_540_4   Y_540_4  \
0    0.000  0.007978 -0.004185  0.000  0.004861 -0.012294 -0.003488 -0.006104
1    0.001  0.017308 -0.001700  0.001 -0.001635 -0.012272  0.003858 -0.008000
2    0.002 -0.005820  0.000828  0.002 -0.002049 -0.014736 -0.003880 -0.005166
3    0.003 -0.005166 -0.000610  0.003  0.001831 -0.011618 -0.002943 -0.005689
4    0.004  0.018245  0.001504  0.004 -0.007411 -0.008741  0.005973 -0.002005

    X_540_6   Y_540_6  …  X_940_10  Y_940_10  X_940_11  Y_940_11  X_940_12  \
0 -0.001134  0.003619  …  0.003728  0.001003  0.002005 -0.004992  0.007368
1 -0.000981  0.003553  …  0.004817 -0.000523  0.002659 -0.002790  0.013885
2  0.002005  0.006670  … -0.007368 -0.003967 -0.000828  0.002616  0.006452
3  0.005711  0.002550  …  0.002005 -0.000785 -0.003292  0.004294  0.002005
4  0.003379 -0.001635  …  0.005995 -0.002768 -0.001853  0.002529  0.006234

   Y_940_12  X_940_-2  Y_940_-2  X_940_-4  Y_940_-4
0 -0.029951 -0.007673 -0.006539 -0.009591  0.003880
1 -0.026812 -0.002463 -0.005973 -0.008523  0.000937
2 -0.019052  0.002071 -0.005319  0.010921 -0.000065
3 -0.023847 -0.006104 -0.007499 -0.004360 -0.006627
4 -0.014212 -0.004839 -0.006104 -0.011335 -0.006910

[5 rows x 47 columns]
```

[3]:
```
z1 = np.polyfit(df.T_540_0, df.X_540_0,2)
z2 = np.polyfit(df.T_540_0, df.Y_540_0,2)
```

[4]:
```
plt.figure(figsize=(10,4))
plt.subplot(1,2,1)
plt.plot(df.T_540_0, df.X_540_0)
plt.plot(df.T_540_0, z1[0]*df.T_540_0**2+z1[1]*df.T_540_0 + z1[2],␣
 ↪label='Trend')
```

```
plt.title('Force in X')
plt.subplot(1,2,2)
plt.plot(df.T_540_0, df.Y_540_0)
plt.plot(df.T_540_0, z2[0]*df.T_540_0**2+z2[1]*df.T_540_0 + z2[2],␣
 ↪label='Trend')
plt.title('Force in Y')
plt.legend()
plt.suptitle('Drift Calculation at RPM 540')
```

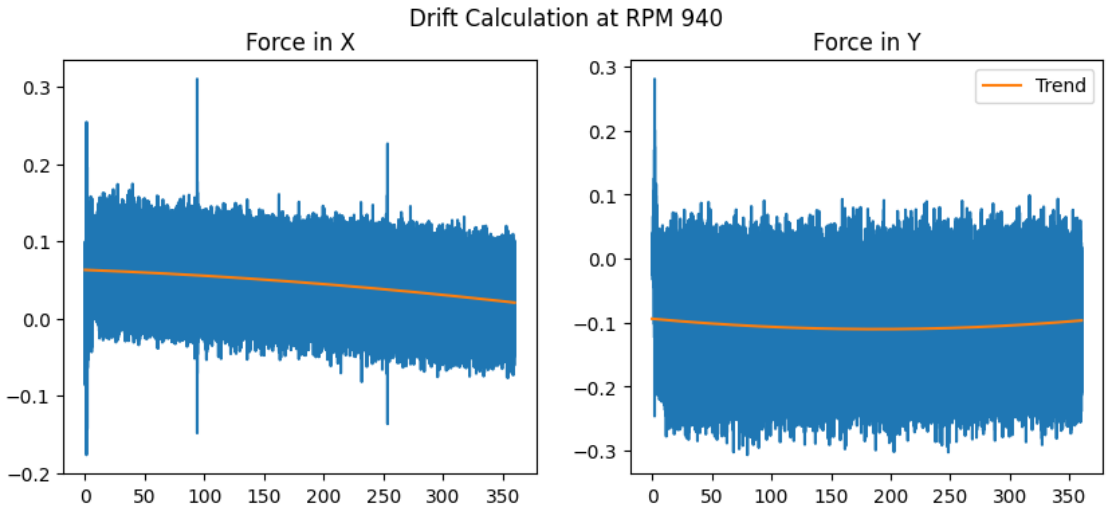
[4]: Text(0.5, 0.98, 'Drift Calculation at RPM 540')



[5]:
```
z1 = np.polyfit(df.T_940_0, df.X_940_0,2)
z2 = np.polyfit(df.T_940_0, df.Y_940_0,2)
```

[6]:
```
plt.figure(figsize=(10,4))
plt.subplot(1,2,1)
plt.plot(df.T_940_0, df.X_940_0)
plt.plot(df.T_940_0, z1[0]*df.T_940_0**2+z1[1]*df.T_940_0 + z1[2],␣
 ↪label='Trend')
plt.title('Force in X')
plt.subplot(1,2,2)
plt.plot(df.T_940_0, df.Y_940_0)
plt.plot(df.T_940_0, z2[0]*df.T_940_0**2+z2[1]*df.T_940_0 + z2[2],␣
 ↪label='Trend')
plt.title('Force in Y')
plt.legend()
plt.suptitle('Drift Calculation at RPM 940')
```

[6]: Text(0.5, 0.98, 'Drift Calculation at RPM 940')



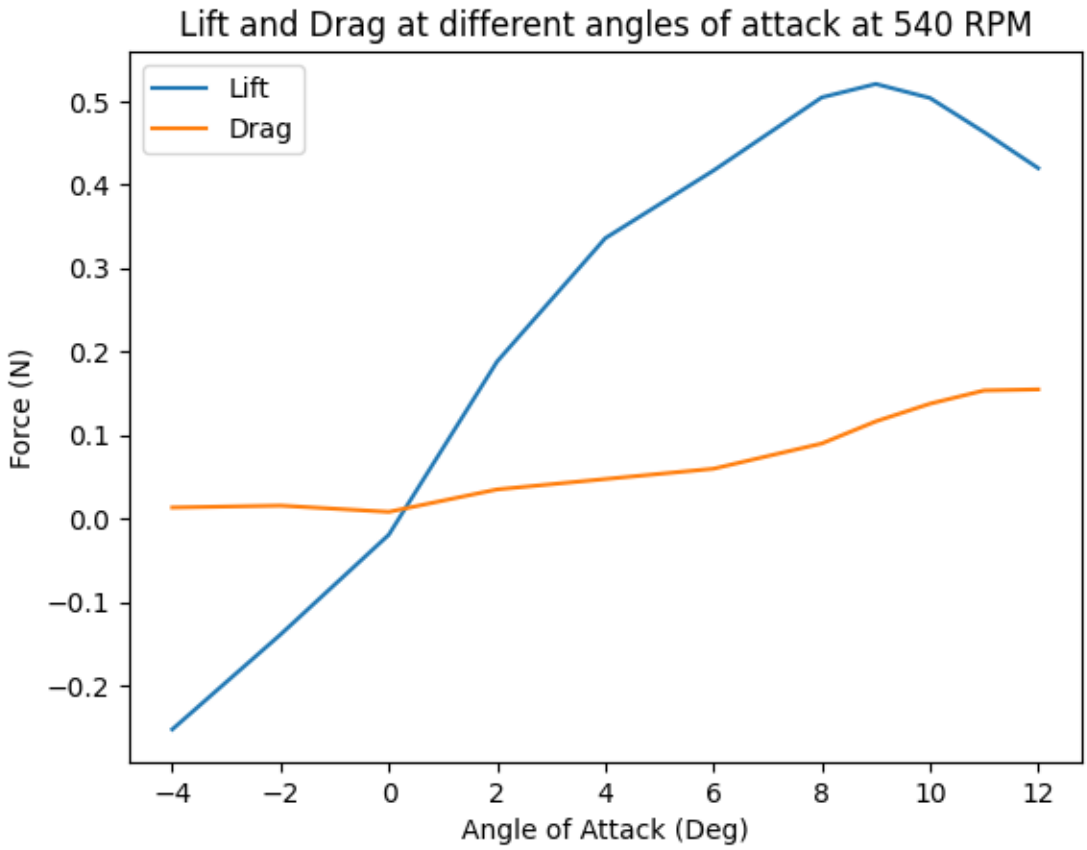
[12]:
```
idx = np.where(df['T']==30)
print(df['T'][idx[0][0]:])
```

```
30000     30.000
30001     30.001
30002     30.002
30003     30.003
30004     30.004
           ...
359995       NaN
359996       NaN
359997       NaN
359998       NaN
359999       NaN
Name: T, Length: 330000, dtype: float64
```

[16]:
```
aoa = np.array([-4, -2, 0, 2, 4, 6, 8, 9, 10, 11, 12])
l540 = []
d540 = []
l940 = []
d940 = []
for i in range(len(aoa)):
    X540 = np.mean(df['X_540_{}'.format(aoa[i])][idx[0][0]:])
    Y540 = np.mean(df['Y_540_{}'.format(aoa[i])][idx[0][0]:])
    X940 = np.mean(df['X_940_{}'.format(aoa[i])][idx[0][0]:])
    Y940 = np.mean(df['Y_940_{}'.format(aoa[i])][idx[0][0]:])
    l540.append(-X540*np.sin(aoa[i]*np.pi/180) - Y540*np.cos(aoa[i]*np.pi/180))
    d540.append(X540*np.cos(aoa[i]*np.pi/180) - Y540*np.sin(aoa[i]*np.pi/180))
    l940.append(-X940*np.sin(aoa[i]*np.pi/180) - Y940*np.cos(aoa[i]*np.pi/180))
    d940.append(X940*np.cos(aoa[i]*np.pi/180) - Y940*np.sin(aoa[i]*np.pi/180))
```

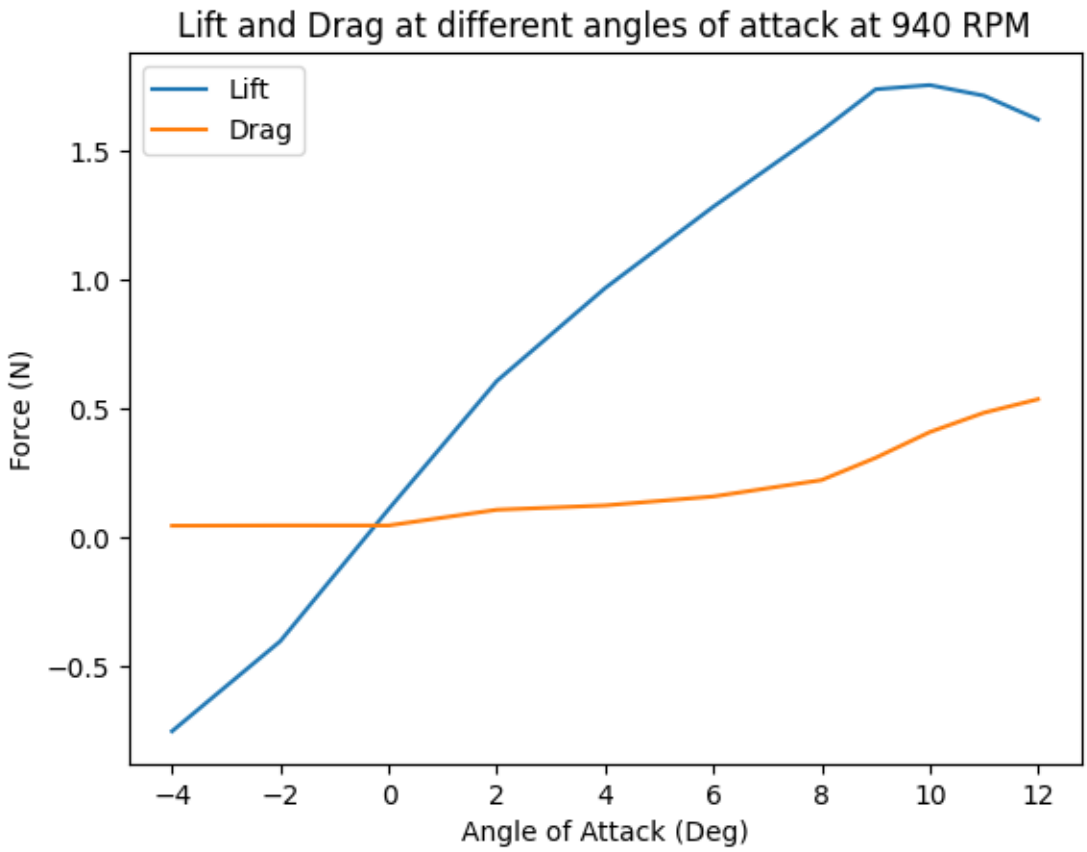
[17]:
```
plt.plot(aoa, l540, label='Lift')
plt.plot(aoa, d540, label='Drag')
plt.title('Lift and Drag at different angles of attack at 540 RPM')
plt.xlabel('Angle of Attack (Deg)')
plt.ylabel('Force (N)')
plt.legend()
```

[17]: <matplotlib.legend.Legend at 0x1cc32d9bce0>



[18]:
```
plt.plot(aoa, l940, label='Lift')
plt.plot(aoa, d940, label='Drag')
plt.title('Lift and Drag at different angles of attack at 940 RPM')
plt.xlabel('Angle of Attack (Deg)')
plt.ylabel('Force (N)')
plt.legend()
```

[18]: <matplotlib.legend.Legend at 0x1cc32dad160>


Lift and Drag at different angles of attack at 940 RPM
Lift
Drag
Force (N)
1.5
1.0
0.5
0.0
−0.5
−4
−2
0
2
4
6
8
10
12
Angle of Attack (Deg)