ECE C143A Homework 6

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April 22, 2022

Problem 1

(a)

False, the Na+ channel opens first

(b)

False, only Na+ serve to depolarize the cell.

(c)

True

(d)

False, EEG's cannot record action potentials.

(e)

False because λ does not vary with time and a possion process is memoryless.

(f)

False, if the Fano factor is greater than one, the firing variance is greater than the firing mean

(g)

True

(h)

False, the

(i)

False

(j)

(m)

False it is a low pass.

(n)

False, good for visual bad for motor

(o)

False, Absolute not relative

Problem 2

(a)

$f(\theta)$ reaces a max at $\theta = \theta_0$ therefore this is the prefered direction.

(b)

No because the values of the tuning curve would all be negative

(c)

$$\begin{aligned}\cos(\theta - \theta_0) &= e^{j(\theta-\theta_0)} \\ &= (\cos(\theta) + j\sin(\theta))(\cos(\theta_0) - j\sin(\theta_0)) \\ &= \cos(theta)\cos(theta_0) + \sin(\theta)\sin(\theta_0)\end{aligned}$$

(d)

$$k_0 = c_0$$
$$k_1 = c_1 \sin(\theta_0)$$
$$k_2 = c_1 \cos(\theta_0)$$

(e)

We have

$$y_0 = 25 = k_0 + k_2$$
$$y_{120} = 70 = k_0 + \frac{k_1\sqrt{3}}{2} - \frac{k_2}{2}$$
$$y_{240} = 10 = k_0 - \frac{k_2}{2} - \frac{k_1\sqrt{3}}{2}$$

Therefore we have

$$y_{120} + y_{240} = 2k_0 - k_2$$
$$2y_0 - y_{120} - y_{240} = 2k_0 + 2k_2 - 2k_0 + k_2$$
$$k_2 = \boxed{\frac{2y_0 - y_{120} - y_{240}}{3}}$$
$$k_0 = \boxed{\frac{y_0 + y_{120} + y_{240}}{3}}$$
$$k_1 = \boxed{\frac{y_{120} - y_{240}}{\sqrt{3}}}$$

(f) and (g)

Problem 2 Jupyter

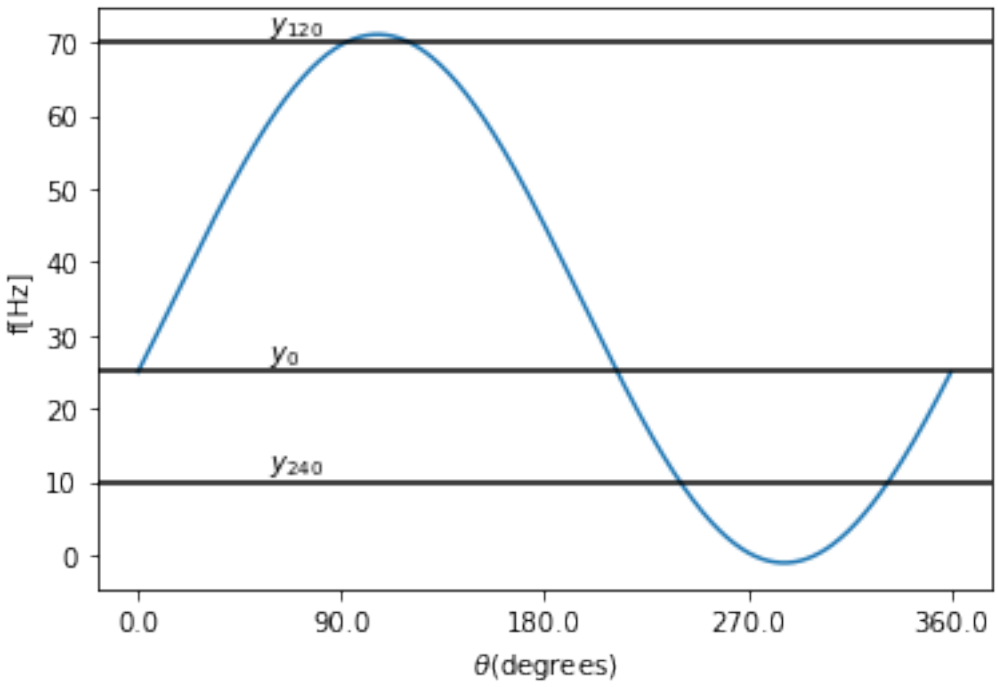
April 22, 2022

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

1 Part (f)

[24]:
```
y0=25
y120=70
y240=10
k0,k1,k2=np.dot(np.linalg.inv([[1,0,1],
                          [1,np.sqrt(3)/2,-1/2],
                          [1,-np.sqrt(3)/2,-1/2]]),[y0,y120,y240])
```

[25]:
```
theta=np.arange(0,2*np.pi,0.01)
f=lambda theta: k0+k1*np.sin(theta)+k2*np.cos(theta)
plt.plot(theta,f(theta))
plt.axhline(y0,color="black")
plt.text(1,y0,"$y_{0}$",va="bottom")
plt.axhline(y120,color="black")
plt.text(1,y120,"$y_{120}$",va="bottom")
plt.axhline(y240,color="black")
plt.text(1,y240,"$y_{240}$",va="bottom")
plt.ylabel("f[Hz]")
plt.xlabel(r"$\theta$(degrees)")
plt.xticks(np.linspace(0,2*np.pi,5),np.linspace(0,360,5))
plt.show()
```



[49]:
```
c1=round(np.sqrt(k1**2+k2**2),3)
c0=k0
theta0=round(np.degrees(np.arctan2(k1,k2)),3)
print(f"c0={c0}")
print(f"c1={c1}")
print(f"theta0={theta0} degrees")
```

```
c0=35.0
c1=36.056
theta0=106.102 degrees
```

2 Part (G)

[66]:
```
theta=np.radians([0,60,120,180,240,300])
y=[25,40,70,30,10,15]

X=np.array([np.sin(theta),np.cos(theta)]).T
```

we can solve for the values of mean squared error by performing a linear regression over k_0, k_1, k_2

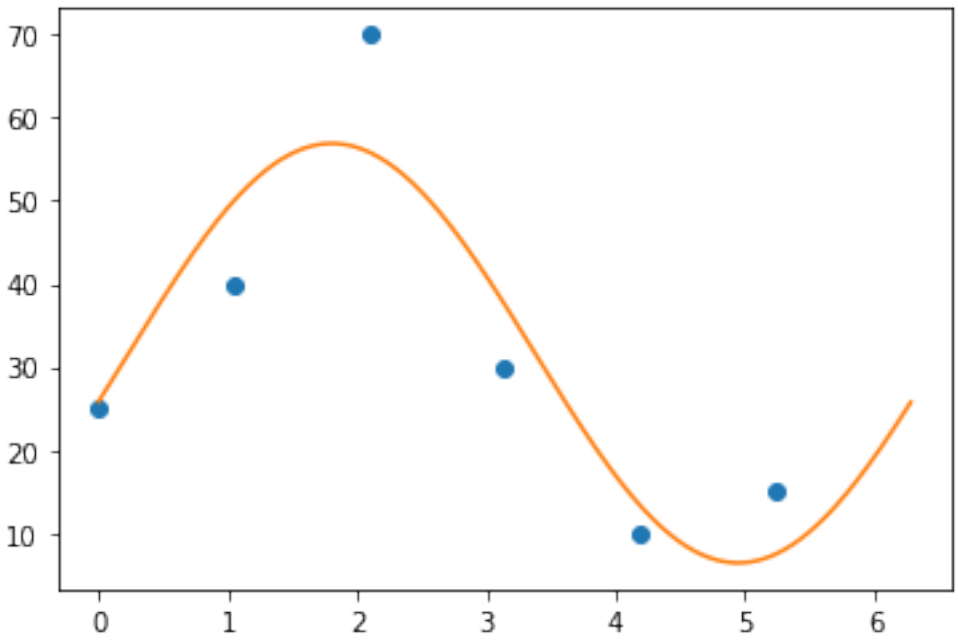
[67]:
```
from sklearn.linear_model import LinearRegression

reg = LinearRegression().fit(X, y)
k0=reg.intercept_
```

```
k1,k2=reg.coef_
c1=round(np.sqrt(k1**2+k2**2),3)
c0=k0
theta0=round(np.degrees(np.arctan2(k1,k2)),3)
print(f"c0={c0}")
print(f"c1={c1}")
print(f"theta0={theta0} degrees")
```

```
c0=31.666666666666664
c1=25.221
theta0=103.373 degrees
```

[68]:
```
plt.plot(theta,y,"o")
theta=np.arange(0,2*np.pi,0.01)
f=lambda theta: k0+k1*np.sin(theta)+k2*np.cos(theta)
plt.plot(theta,f(theta))
```

[68]: [<matplotlib.lines.Line2D at 0x7fdb0039a910>]



Problem 3

Problem 4

(a)

$$\frac{1}{\lambda}$$

(b)