

hw10

November 8, 2016

1 2. Mechanical: Correlation

```
In [42]: %pylab inline
import numpy as np
import matplotlib.pyplot as plt
from scipy.linalg import circulant
```

Populating the interactive namespace from numpy and matplotlib

```
In [43]: s1 = np.array([1,-1,1,-1,-1,-1,1,-1,1,1])
s2 = np.array([1,2,3,4,5,6,7,6,5,4])
print("signal 1 = ", s1)
print("signal 2 = ", s2)
```

```
signal 1 = [ 1 -1  1 -1 -1 -1  1 -1  1  1]
signal 2 = [1 2 3 4 5 6 7 6 5 4]
```

1.1 (a) autocorrelation

```
In [46]: c1 = circulant(s1).transpose()
c2 = circulant(s2).transpose()
```

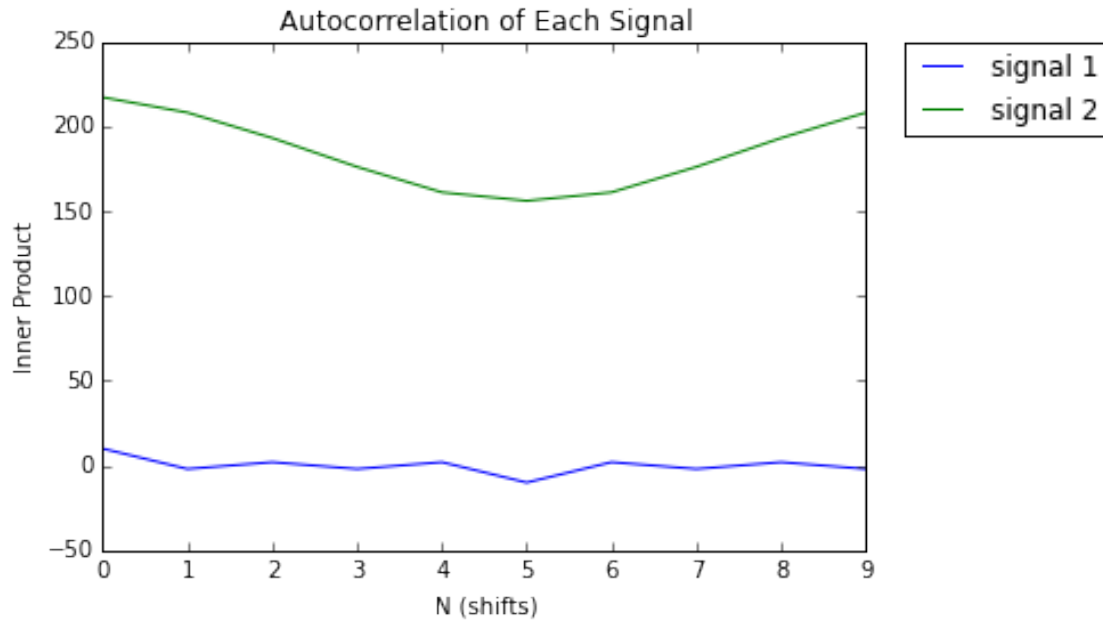
```
In [78]: auto1 = np.dot(c1,s1)
print ("Autocorrelation of signal 1: ", auto1)
auto2 = np.dot(c2,s2)
print ("Autocorrelation of signal 2: ", auto2)
```

```
Autocorrelation of signal 1: [ 10 -2  2 -2  2 -10  2 -2  2 -2]
Autocorrelation of signal 2: [217 208 193 176 161 156 161 176 193 208]
```

```
In [79]: plt.title('Autocorrelation of Each Signal')
plt.plot(auto1, label='signal 1')
plt.plot(auto2, label='signal 2')
plt.xlabel('N (shifts)')
plt.ylabel('Inner Product')

plt.legend(bbox_to_anchor=(1.05, 1), loc=0, borderaxespad=0.)
```

```
Out[79]: <matplotlib.legend.Legend at 0x10c450fd0>
```



1.2 (b) cross-correlation

```
In [77]: cross1 = np.dot(c2,s1)
          print ("Cross-correlation 1: ", cross1)
          cross2 = np.dot(c1,s2)
          print ("Cross-correlation 2: ", cross2)

Cross-correlation 1: [ -3  3  5 11  9  3 -3 -5 -11 -9]
Cross-correlation 2: [ -3 -9 -11 -5 -3  3  9 11  5  3]

In [80]: plt.title('Cross-correlations')
          plt.plot(cross1)
          plt.plot(cross2)
          plt.xlabel('N (shifts)')
          plt.ylabel('Inner Product')

Out[80]: <matplotlib.text.Text at 0x10c461a20>
```

