Wiener-Yule

April 14, 2015

```
In [2]: import numpy as np
        import scipy, scipy.linalg, scipy.signal
        import matplotlib.pyplot as plt
        import pickle
        import pylab
        pylab.rcParams['figure.figsize'] = (14.0, 8.0)

        %matplotlib inline
```

1 Préliminaires

Comment calculer l'estimation de l'inter-corrélation de deux signaux `x` et `y` en python ?

```
n = 10

# regularisation par le nombre de termes
regul = np.correlate(np.ones(n), np.ones(n), "full")

# corrélation
corr = np.correlate(x, y, "full") / regul

# Récupération de RXY[0]
RXY0 = corr[n-1]
```

Comment utiliser la fonction `scipy.signal.lfilter` avec les coefficients h d'un RIF obtenus pour Wiener ou Yule-Walker ?

`scipy.signal.lfilter(b, a, x, axis=-1, zi=None)`

a = [1]

b = h

Comment calculer une toeplitz ou une matrice inverse grâce à `scipy.linalg` ?

`scipy.linalg.toeplitz` et `scipy.linalg.inv`.

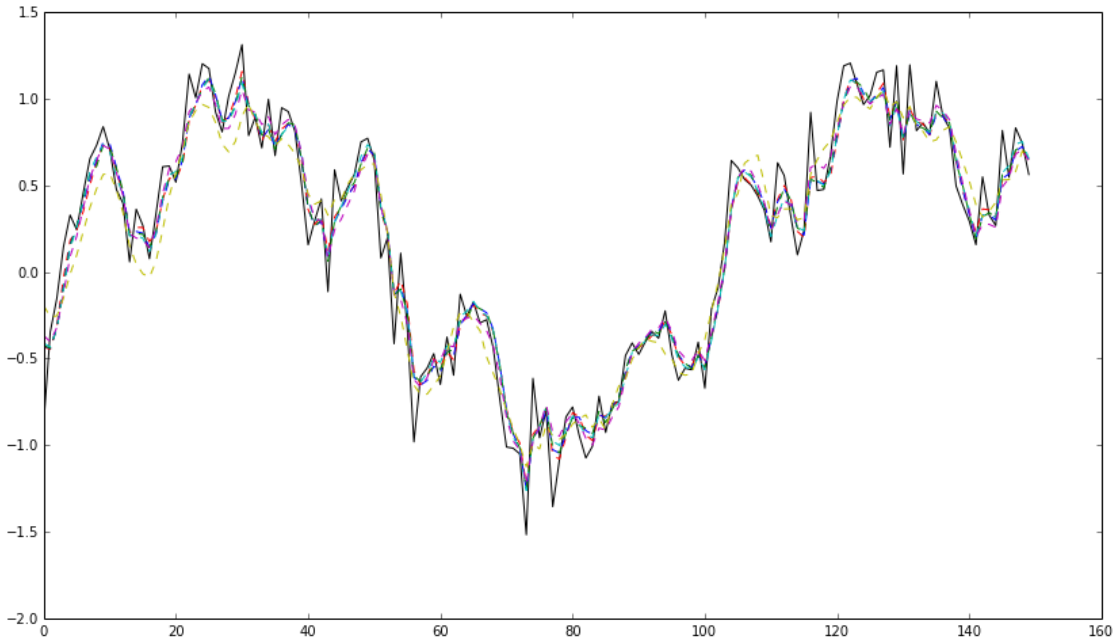
```
In [3]: # Load data

        dataAll = pickle.load(open('TDWiener.pick', 'rb'))
```

2 Filtrage

```
In [41]: data = dataAll['EX1']

         xtrain = data['train']['x']
         ytrain = data['train']['y']
         btrain = data['train']['b']
         ytest = data['test']['y']
```

2.1 Wiener : Forme générale

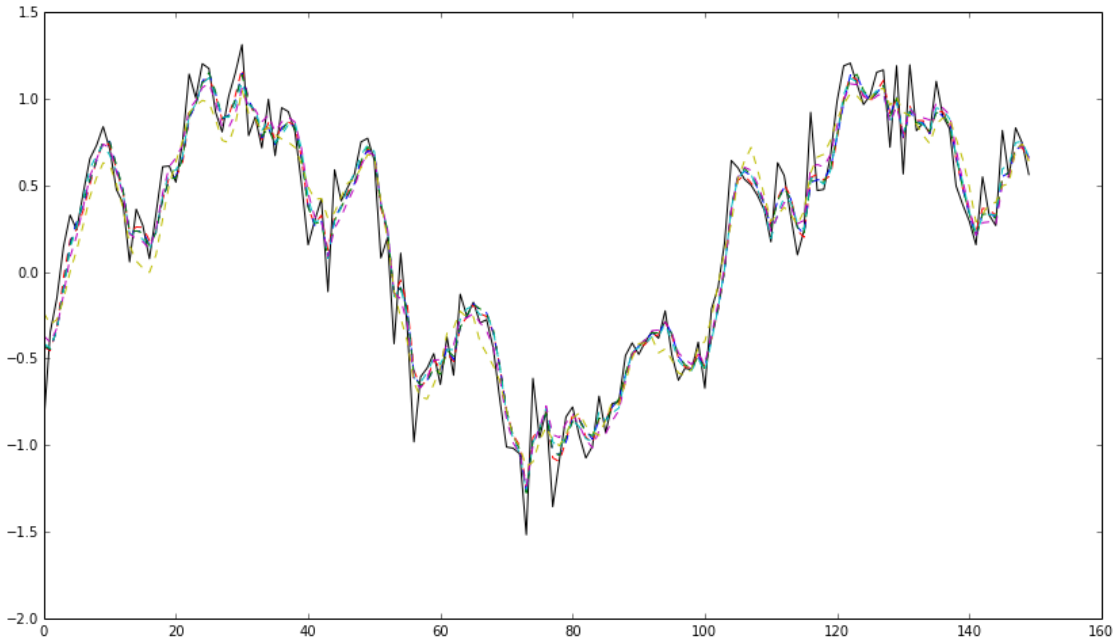
In [42]:
```
n = np.size(ytrain)

    # plot original data
    plt.plot(ytest[0:150], 'k')

    # for each p
    for (p, color) in zip([2, 5, 7, 10, 20, 30], ['r--', 'b--', 'g--', 'c--', 'm--', 'y--']):

        # compute correlations
        regul = np.correlate(np.ones(n), np.ones(n), "full")
        RYY = np.correlate(ytrain, ytrain, "full") / regul
        RXY = np.correlate(xtrain, ytrain, "full") / regul

        RYYmat = scipy.linalg.toeplitz(RYY[n-1:n+p+1])
        RXY = RXY[n-1:n+p+1]

        h = np.dot(np.linalg.inv(RYYmat), RXY)

        xtest = scipy.signal.lfilter(h, [1], ytest)
        plt.plot(xtest[0:150], color)
```



2.2 Wiener : Bruit non-corrélé

In [34]:
```
n = np.size(ytrain)

    # plot original data
    plt.plot(ytest[0:150], 'k')

    # for each p
```

```
for (p, color) in zip([2, 5, 7, 10, 20, 30], ['r--', 'b--', 'g--', 'c--', 'm--', 'y--']):

    regul = np.correlate(np.ones(n), np.ones(n), "full")
    RX = np.correlate(xtrain, xtrain, "full") / regul
    RB = np.correlate(btrain, btrain, "full") / regul

    RXmat = scipy.linalg.toeplitz(RX[n-1:n+p+1])
    RBmat = scipy.linalg.toeplitz(RB[n-1:n+p+1])
    RXpBmat = RXmat + RBmat
    RX = RX[n-1:n+p]

    h = np.dot(np.linalg.inv(RXpBmat), RX)

    xtest = scipy.signal.lfilter(h, [1], ytest)
    plt.plot(xtest[0:150], color)
```



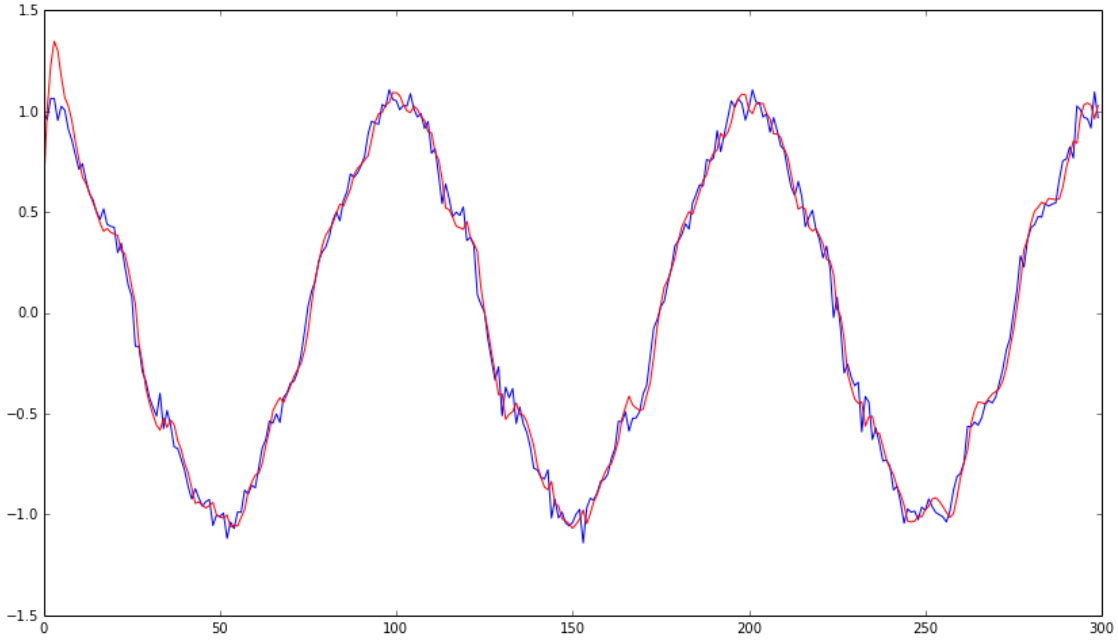
3 Prédiction (Yule-Walker)

In [62]:
```
data = dataAll['EX2']
ytest = data['test']['y']
ytrain = data['train']['y']
```

In [86]:
```
n = np.size(ytrain)
p = 10

# compute correlations
regul = np.correlate(np.ones((n,)), np.ones((n,)), "full")
RYYnc = np.correlate(ytrain, ytrain, "full")
RYYfull = RYYnc / regul
RYY = RYYfull[n-1:]
```

```
RYYmat = scipy.linalg.toeplitz(RYY[:p])
RYY1p = RYY[1:p+1] # 1 à p

h = np.linalg.inv(RYYmat).dot(RYY1p)
h = h.reshape((p,))

xtest = scipy.signal.lfilter(h, [1], ytest)
plt.plot(ytest[1:301], 'b')
plt.plot(xtest[0:300], 'r')
```

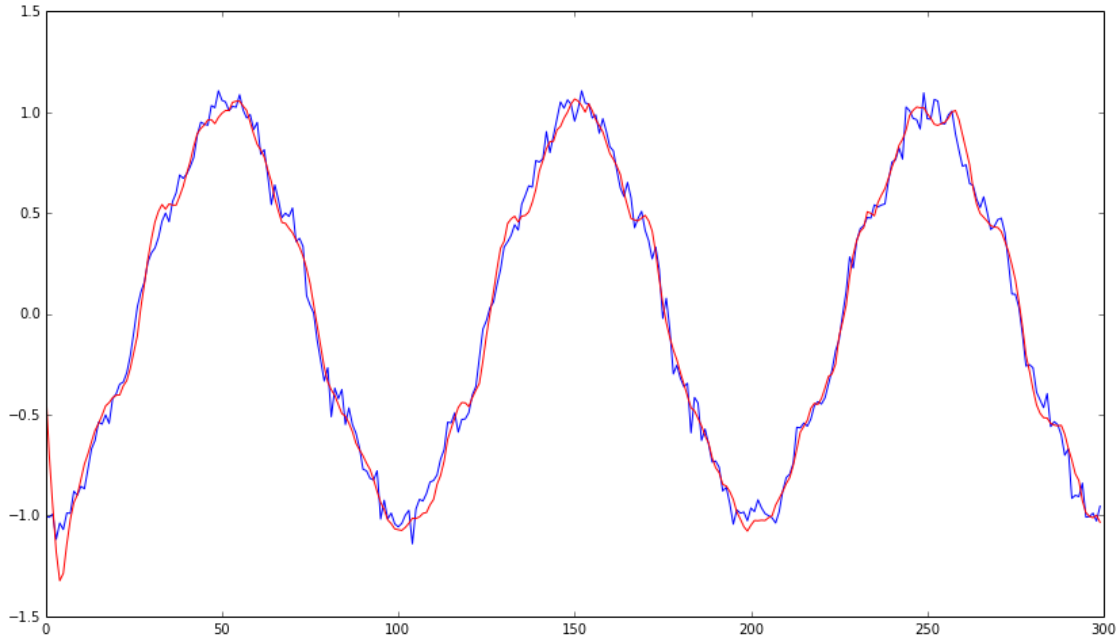
Out[86]: [<matplotlib.lines.Line2D at 0x1adc65c0>]



In [87]:
```
n = np.size(ytrain)
p = 10
n0 = 50

# compute correlations
regul = np.correlate(np.ones((n,)), np.ones((n,)), "full")
RYYnc = np.correlate(ytrain, ytrain, "full")
RYYfull = RYYnc / regul
RYY = RYYfull[n-1:]

RYYmat = scipy.linalg.toeplitz(RYY[:p])
RYY1p = RYY[n0:p+n0] # n0 à p + n0 - 1

h = np.linalg.inv(RYYmat).dot(RYY1p)
h = h.reshape((p,))

xtest = scipy.signal.lfilter(h, [1], ytest)
```

```
plt.plot(ytest[n0:300+n0], 'b')
plt.plot(xtest[0:300], 'r')
```

```
Out[87]: [<matplotlib.lines.Line2D at 0x1ef92898>]
```



4 La vie la vraie

```
In [19]: import cvxpy as cvx
```

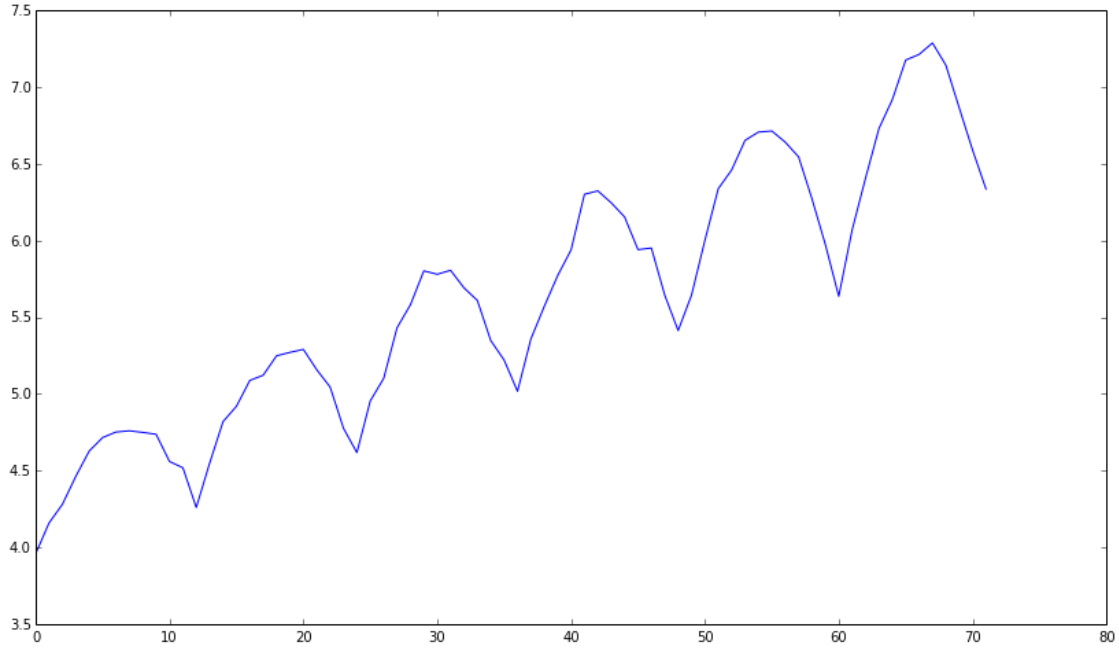
```
C:\Anaconda\lib\site-packages\cvxpy\problems\problem.py:49: UserWarning: The solver SCS could not be imp
  warnings.warn("The solver SCS could not be imported.")
```

```
In [ ]: A = np.ones(n,m)
        b = np.zeros()

        A[:,0] = t
        b[:,0] = y
```

```
In [25]: ytest = dataAll['EX3']['test']['y']
```

```
In [26]:
```

```
Out[26]: [<matplotlib.lines.Line2D at 0x14d976d8>]
```


7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
0
10
20
30
40
50
60
70
80