OPTIMIZATION THEORY

DMDO

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Introduction to the problem

We want to implement a method of direct dynamical optimization without additional constraints.

In order to make it we start from these formulas:

$$x_{n+1} = Ax_n^2 + Bu_n^2$$

$$J = \sum_{n=0}^{n-1} \left(Q\, x_n^2 + Ru_n^2 \right)$$

With the parameters directly passed to the program A, B, Q, R, x0

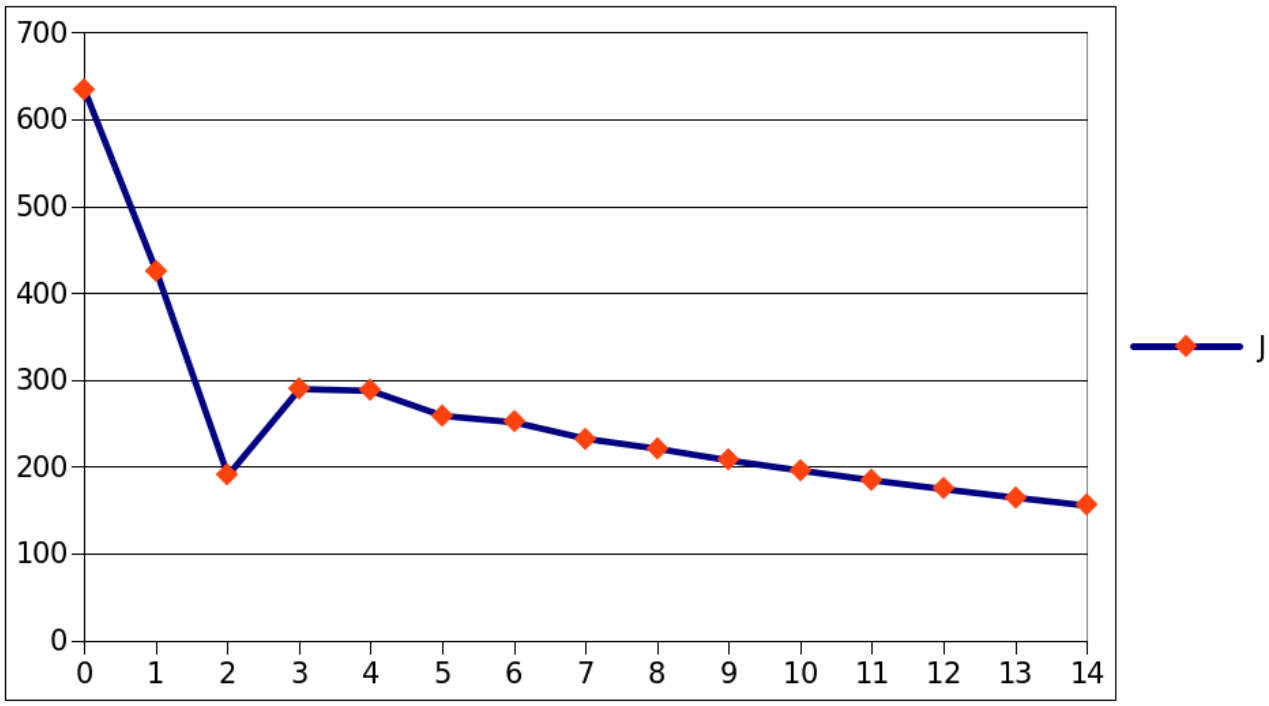
Implementation

This is the main function, it runs all the procedure of our algorithm

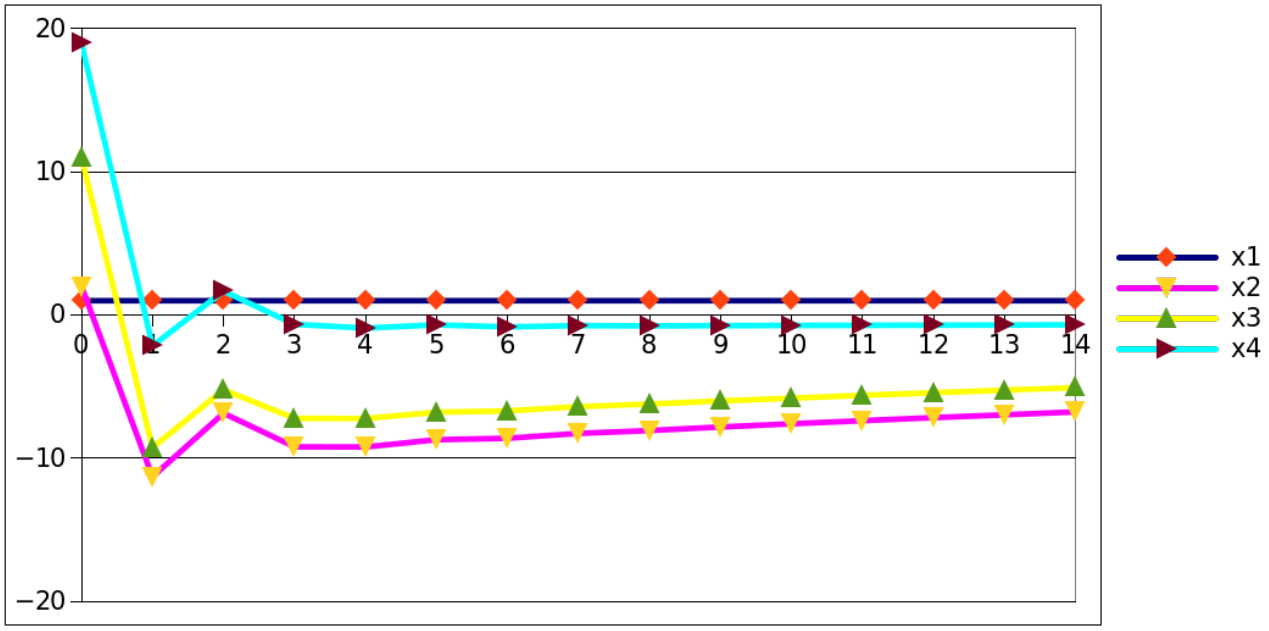
```
def dynamicOptimization(self, A, B, Q, R, x0, n, k):
    toptimal = 0.010
    x = [[0 for x in range(n)] for y in range(k)]
    u = [[0 for x in range(n)] for y in range(k)]
    b = [[0 for x in range(n)] for y in range(k)]
    p = [[0 for x in range(n+1)] for y in range(k)]
    Ji = [0 for x in range(k)]
    u[0] = self.initial
    for i in range(0, k):
        x[i][0] = x0
        for j in range(1, n):
            x[i][j] = x[i][j - 1] + u[i][j - 1]

        for j in reversed(range(0, n+1)):
            if j == n :
                p[i][j] = 0
            else:
                p[i][j] = 2*Q*x[i][j] + p[i][j+1]*2*A*x[i][j]

        for j in range(0, n):
            b[i][j] = 2*R*u[i][j] + p[i][j + 1]
        for j in range(0, n ):
            if i + 1 < k:
                u[i + 1][j] = u[i][j] - toptimal * b[i][j]

        sum = 0
        for j in range(n):
            sum += x[i][j]**2 + u[i][j]**2
        Ji[i] = sum


        print("U: ", *u[i] , "x: ", *x[i], "J: ", Ji[i])

    self.U = u
    self.J = Ji
    self.X = x
```

Results

We run the program under 15 iterations: This the graphic iterations/J:



And this is the graphic for each trajectory:



We can see a gradual minimization of our results for every iteration.