Layout-Optimization-SQP-2

June 26, 2022

[1]:

```
%load_ext autoreload
%autoreload 2
```

[2]:

```
import numpy as np
from scipy import optimize
import sys

sys.path.insert(1, '../src')
from plant import Plant
import utils
from optimization1 import *
```

[3]:

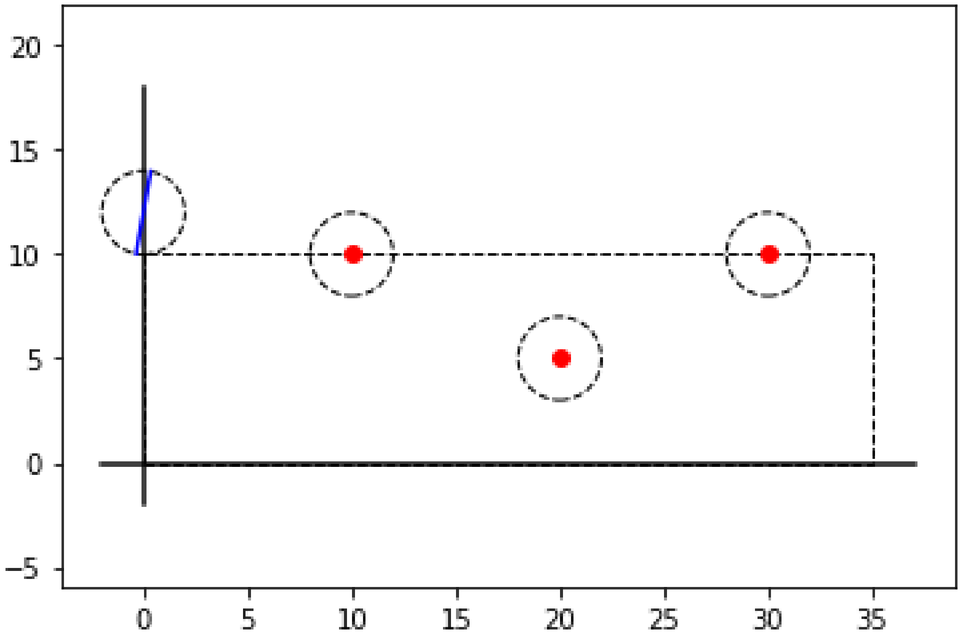
```
hypo_plant = utils.load("../data/plants/tiny-plant.json")

basic_layout = np.array([[10, 10], [20, 5], [30, 10]])

plant = Plant(hypo_plant, basic_layout)

## check result:
print(plant.valid_layout)
print(utils.get_energy(plant))
plant.draw()
```

```
True
21.748093560879155
```



[4]:
```python
def f(x):
    plant.layout = x.reshape((3, 2))
    plant.set_layout()
    return -utils.get_energy(plant)
```

[5]:
```python
x0 = basic_layout.flatten()
x0
```

[5]:
```
array([10, 10, 20,  5, 30, 10])
```

[6]:
```python
f(x0)
```

[6]:
```
-21.748093560879155
```

[7]:
```python
bounds = []
for i in range(3):
    bounds.append((0, 35))
    bounds.append((0, 10))
bounds
```

[7]:
```
[(0, 35), (0, 10), (0, 35), (0, 10), (0, 35), (0, 10)]
```

[8]:
```python
def g01(x):
    i, j = 0, 1
    layout = x.reshape(3, 2)
    distance = np.linalg.norm(layout[i] - layout[j])
    return distance - 4

def g02(x):
    i, j = 0, 2
    layout = x.reshape(3, 2)
    distance = np.linalg.norm(layout[i] - layout[j])
    return distance - 4

def g12(x):
    i, j = 1, 2
    layout = x.reshape(3, 2)
    distance = np.linalg.norm(layout[i] - layout[j])
    return distance - 4

## TODO: auto generate (n choose 2) constraints
# constraints = []
# for i in range n:
#   for j in range i+1, n:
#       constraints.append({ lambda x: g(i,j) })

constraints = [{"type": "ineq", "fun": g01},
               {"type": "ineq", "fun": g02},
               {"type": "ineq", "fun": g12}]
```

[9]:

```
result = optimize.minimize(f, x0,
                           method="SLSQP",
                           bounds=bounds,
                           constraints=constraints,
                           options={'disp': True, 'maxiter': 100})
```

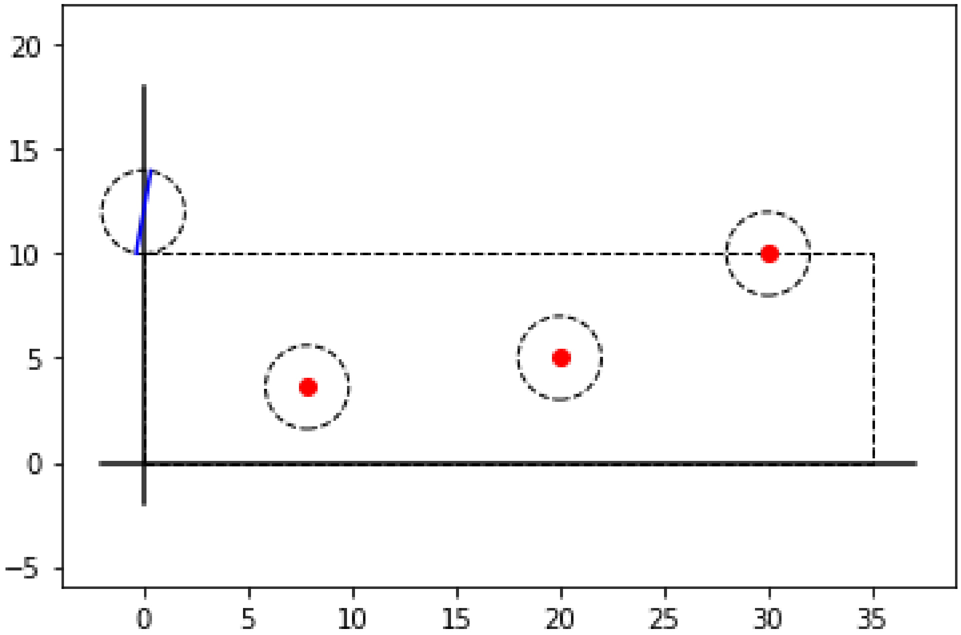
```
Optimization terminated successfully    (Exit mode 0)
            Current function value: -41.033956692960274
            Iterations: 28
            Function evaluations: 317
            Gradient evaluations: 28
```

[10]:

```
print(result["x"])
print(result)

plant.layout = result['x'].reshape((3, 2))
plant.set_layout()
print(plant.valid_layout)
print(utils.get_energy(plant))
plant.draw()
```

```
[ 7.86264511  3.60361985 20.          5.         30.         10.        ]
     fun: -41.033956692960274
     jac: array([ 0.52402258,  0.48407221,  0.        ,  0.        ,  0.
,
       -0.        ])
 message: 'Optimization terminated successfully'
    nfev: 317
     nit: 28
    njev: 28
  status: 0
 success: True
       x: array([ 7.86264511,  3.60361985, 20.        ,  5.        , 30.
,
       10.        ])
True
41.033956692960274
```



```
[ ]:
```