In [1]:

```
from Scipy_DE import DifferentialEvolution
from examples import PressureVessel, TensionCompressionSpring, SpeedReducer
import pandas as pd
```

In [2]:

```
N = 30
G = 250

config = {'case1':{'mutation':0.5, 'recombination':0.7},
          'case2':{'mutation':0.1, 'recombination':0.8},
          'case3':{'mutation':0.8, 'recombination':0.6}}

#Python uses the Mersenne Twister as the core generator: https://docs.python.
def run(algorithm, problem, N, G, config):
    res = dict()
    for case in config:
        res[case] = []
        for i in range(N):
            alg = algorithm(problem.problem, problem.bounds, seed=i, G=G, **co
            alg.popsize=15 #population
            alg.run()
            res[case].append(alg.fun)
    return res
```

Design of Pressure Vessel

Optimization problem (minimization OR maximization): Minimization

Brief description of the optimization problem (2 paragraphs and link)

4.3.1 Example 8: Design of Pressure Vessel:

A cylindrical vessel is capped at both ends by hemispherical heads. The objective is to minimize the total cost, including the cost of the material, forming and welding.

There are four design variables: thickness of the shell (Ts), thickness of the head (Th), inner radius (R) and length of the cylindrical section of the vessel, not including the head (L) so design vector X = (x1, x2, x3, x4) = (Ts, Th, R, L). Ts and Th are integer multiples of 0.0625 inch, which are the available thicknesses of rolled steel plates, and R and L are continuous.

-Mechanical Design Optimization Using Advanced Optimization Techniques

Dimension of optimization problem: 4 D

Population size: 15 members

Stopping criterion: 250 generations

Number of runs: 30

Differencial Evolution

In [3]:

```
res_de = run(algorithm=DifferentialEvolution, problem=PressureVessel(), N=N, (

df_de = pd.DataFrame(res_de)

print('DE - PressureVessel')
print(df_de.describe())
```

```
DE - PressureVessel
             case1         case2        case3
count    30.000000     30.000000    30.000000
mean   6476.948448   9784.676313  6092.374045
std     413.416141  13014.864002    82.679927
min    6060.591995   6090.829314  6059.731881
25%    6091.214704   6286.148668  6061.021478
50%    6390.846848   6646.514272  6063.480757
75%    6772.715736   7258.685089  6091.707510
max    7334.724031  77210.415340  6411.791999
```

Design of Pressure Vessel

Optimization problem (minimization OR maximization): Minimization

Brief description of the optimization problem (2 paragraphs and link)

4.3.3 Example 10: Design of Tension/Compression Spring

This problem is taken from Belegundu which consists of minimizing the weight of a tension/compression spring subject to constraints on minimum deflection, shear stress, surge frequency, limits on outside diameter and on design variables.

The design variables are the wire diameter (d), the mean coil diameter (D) and the number of active coils (N). Design vector can be defined as X = (x1, x2, x3) = (d, D, N).

-Mechanical Design Optimization Using Advanced Optimization Techniques

Dimension of optimization problem: 3 D

Population size: 15 members

Stopping criterion: 250 generations

Number of runs: 30

Differencial Evolution

In [4]:

```
res_de = run(algorithm=DifferentialEvolution, problem=TensionCompressionSprin

df_de = pd.DataFrame(res_de)

print('DE - TensionCompressionSpring')
print(df_de.describe())
```

```
DE - TensionCompressionSpring
           case1      case2      case3
count  30.000000  30.000000  30.000000
mean    0.012804   0.018485   0.012698
std     0.000149   0.010237   0.000028
min     0.012667   0.012677   0.012671
25%     0.012685   0.013840   0.012678
50%     0.012712   0.014974   0.012687
75%     0.012918   0.017931   0.012708
max     0.013140   0.055209   0.012799
```

Design of a Speed Reducer

Optimization problem (minimization OR maximization): Minimization

Brief description of the optimization problem (2 paragraphs and link)

4.3.4 Example 11: Design of a Speed Reducer:

The weight of the speed reducer as shown in Fig. 4.4 is to be minimized subject to constraints on bending stress of the gear teeth, surfaces stress, transverse deflec- tions of the shafts and stresses in the shafts.

The variables x1, x2, x3, x4, x5, x6 and x7 are the face width, module of teeth, number of teeth in the pinion, length of the first shaft between bearings, length of the second shaft between bearings and the diameter of the first and second shafts, respectively. The third variable is integer, the rest of them are continuous.

-Mechanical Design Optimization Using Advanced Optimization Techniques

Dimension of optimization problem: 7 D

Population size: 15 members

Stopping criterion: 250 generations

Number of runs: 30

Differencial Evolution

In [5]:

```
res_de = run(algorithm=DifferentialEvolution, problem=SpeedReducer(), N=N, G=(

df_de = pd.DataFrame(res_de)

print('DE - SpeedReducer')
print(df_de.describe())
```

```
DE - SpeedReducer
             case1        case2        case3
count    30.000000    30.000000    30.000000
mean   2998.551847  3204.950537  3002.327741
std       3.722099   385.060737     3.335873
min    2993.872637  2993.188563  2997.334565
25%    2996.081460  3000.381746  2999.647216
50%    2997.291385  3008.295104  3001.929184
75%    2999.569033  3360.832122  3003.939163
max    3008.563380  4665.124869  3011.041617
```