Reliable frequency

Change the number of units

POPSIZE = 150   Crossover rate = 0.8 Mutation rate =0.01 Unite number=5   24.81

100	100	100
100	100	100

POPSIZE = 150   Crossover rate = 0.8 Mutation rate =0.01 Unite number=10   165.753

88	85	91
100	100	100

POPSIZE = 150   Crossover rate = 0.8 Mutation rate =0.01 Unite number=20   630.77

35	29	42
100	100	100
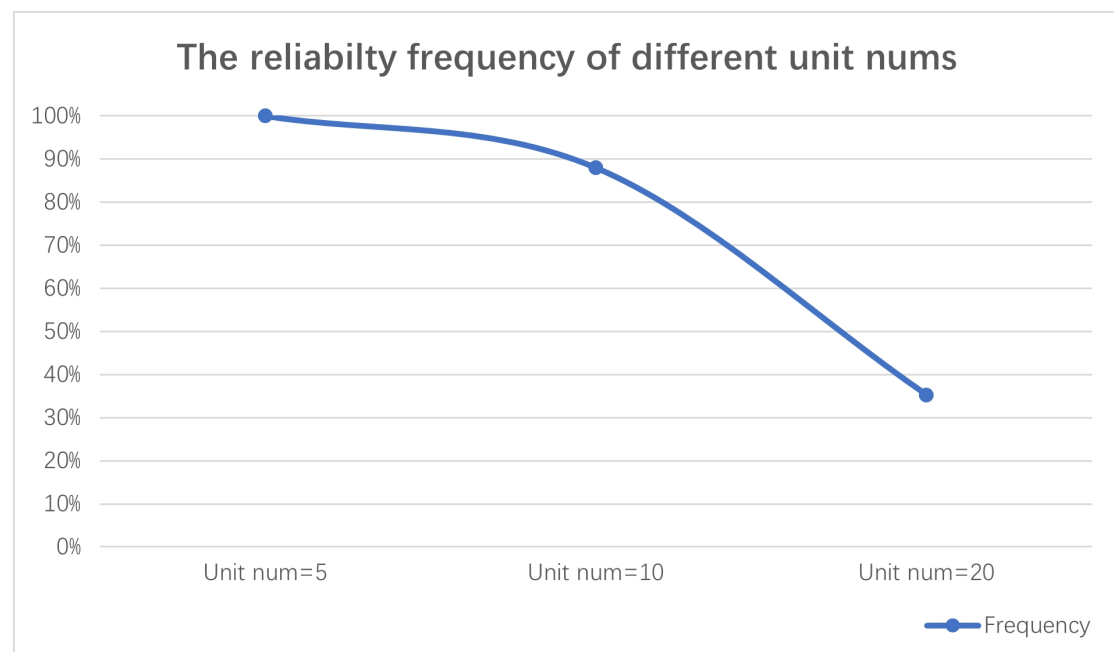
Figure 1

Change the POPSIZE

POPSIZE=100   Crossover rate = 0.8   Mutation rate   =0.01 Unite number =10

83	77	79
100	100	100

POPSIZE=200   Crossover rate = 0.8   Mutation rate   =0.01 Unite number =10

94	85	88
100	100	100

POPSIZE=300　Crossover rate = 0.8　Mutation rate　=0.01 Unite number =10

91	92	93
100	100	100

POPSIZE=400　Crossover rate = 0.8　Mutation rate　=0.01 Unite number =10

91	94	95
100	100	100

POPSIZE=500　Crossover rate = 0.8　Mutation rate　=0.01 Unite number =10

82	93	91
100	100	100
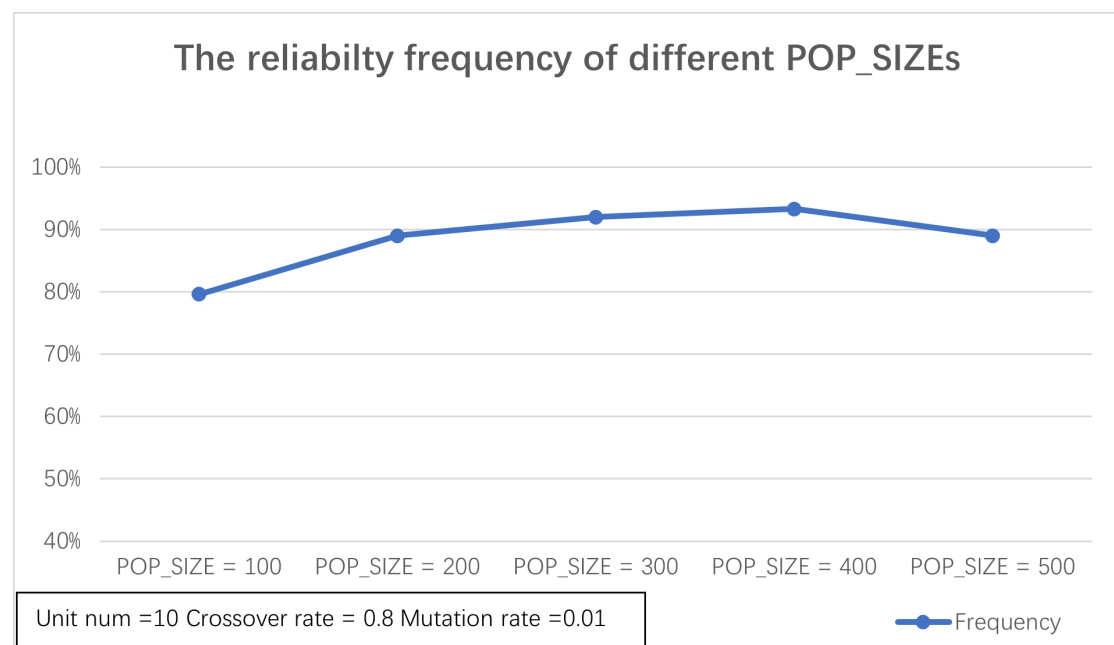
Figure 2

Change mutation rate

POPSIZE=150　Crossover rate = 0.8 Mutation rate =0.001 Unite number = 10

62	60	68
100	100	100

POPSIZE=150　Crossover rate = 0.8 Mutation rate =0.005 Unite number = 10

85	89	85
100	100	100

POPSIZE=150　Crossover rate = 0.8 Mutation rate =0.01 Unite number = 10

90	91	90
100	100	100

POPSIZE=150   Crossover rate = 0.8 Mutation rate =0.02 Unite number = 10

84	88	86
100	100	100

POPSIZE=150   Crossover rate = 0.8 Mutation rate =0.05 Unite number = 10

85	87	92
100	100	100
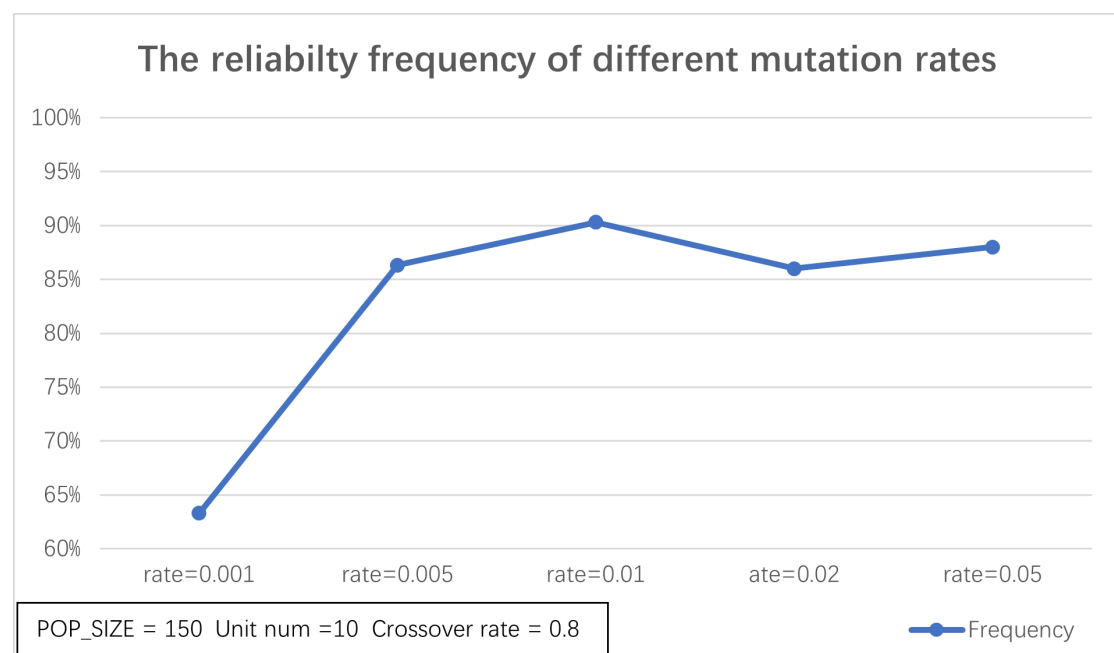
Figure 3

Change Crossover rate

POPSIZE=150   Crossover rate = 0.8 mutation rate = 0.01   Unite number = 10

88	85	91
100	100	100

POPSIZE=150   Crossover rate = 0.85 mutation rate = 0.01   Unite number = 10

95	86	85
100	100	100

POPSIZE=150   Crossover rate = 0.9 mutation rate = 0.01   Unite number = 10

91	90	85
100	100	100

POPSIZE=150   Crossover rate = 0.95 mutation rate = 0.01   Unite number = 10

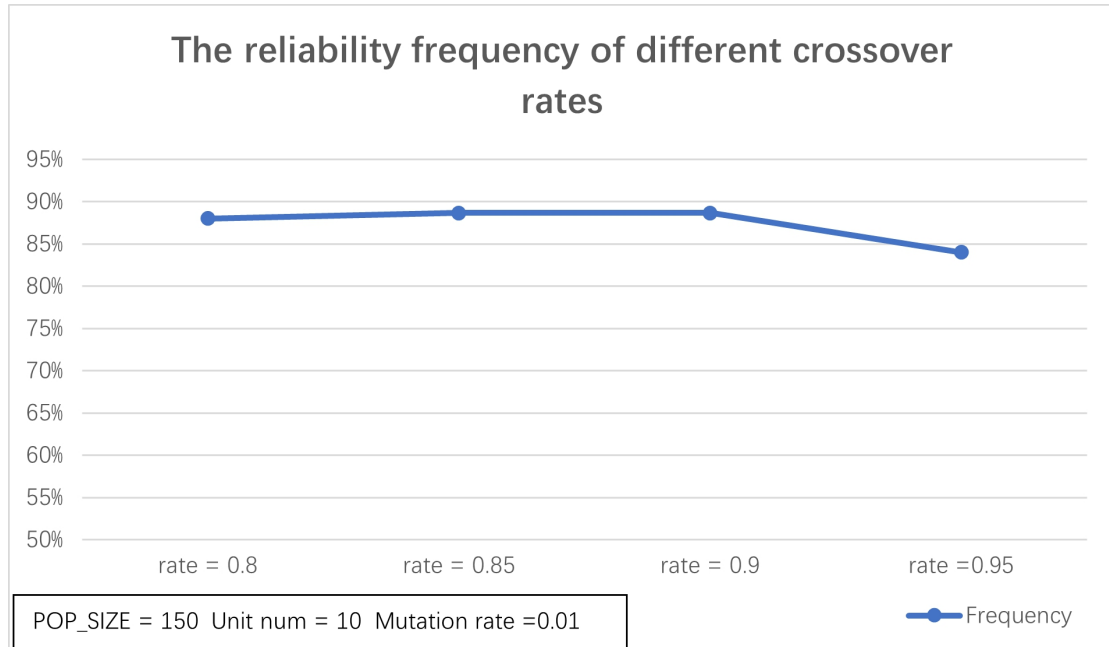| 84	91	77
100	100	100

Figure 4

From figure 1, it shows that the frequency with unit number that equal to 5, is close to 100%. When units num equals 10, the frequency is reduced to around 90%.   When units number equals 20, the frequency speed drops to around thirty five percent%. Therefore, for this algorithm, the reliability frequency decreases as the number of units increases. From figure 2 and 3, we can find that Initially, the incrementation in either population size or mutation rate will lead to incrementation in frequency. However, later, the frequency stabilizes at around 90%, which means our performance is robust to deal with the circuit containing ten units. For figure 4, the crossover rate in range from 0.8 to 0.95, it seems that no matter what the crossover rate is, it seems to have little effect on frequency.

Speed

Change unit numbers

POPSIZE=150   Crossover rate=0.8   Mutation rate=0.001

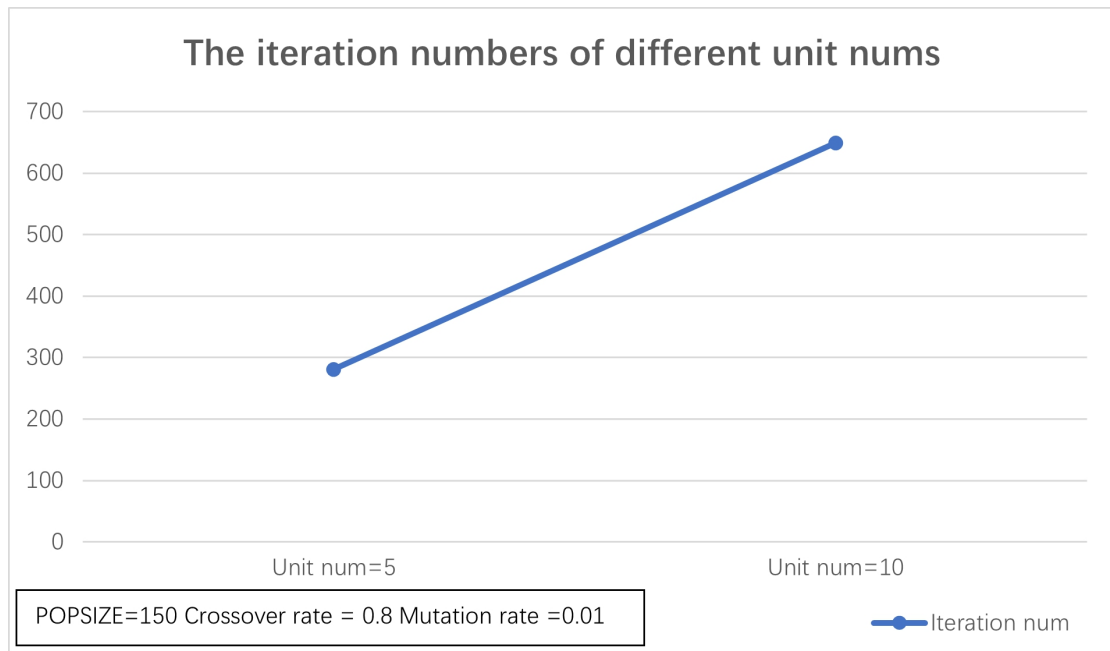|	Generation of convergence
unit number =5	281
unit number =10	649

The iteration numbers of different unit nums

POPSIZE=150 Crossover rate = 0.8 Mutation rate =0.01

Iteration num

Figure 5

Change POPSIZE

Crossover rate = 0.8 mutation rate = 0.001   unit number =10

	Generation of convergence
POPSIZE=100	1182
POPSIZE =200	681
POPSIZE =300	629
POPSIZE =400	620
POPSIZE =500	539

The iteration numbers of differernt POP_SIZEs

Unit num =10 Crossover rate = 0.8 Mutation rate =0.01

Iteration num
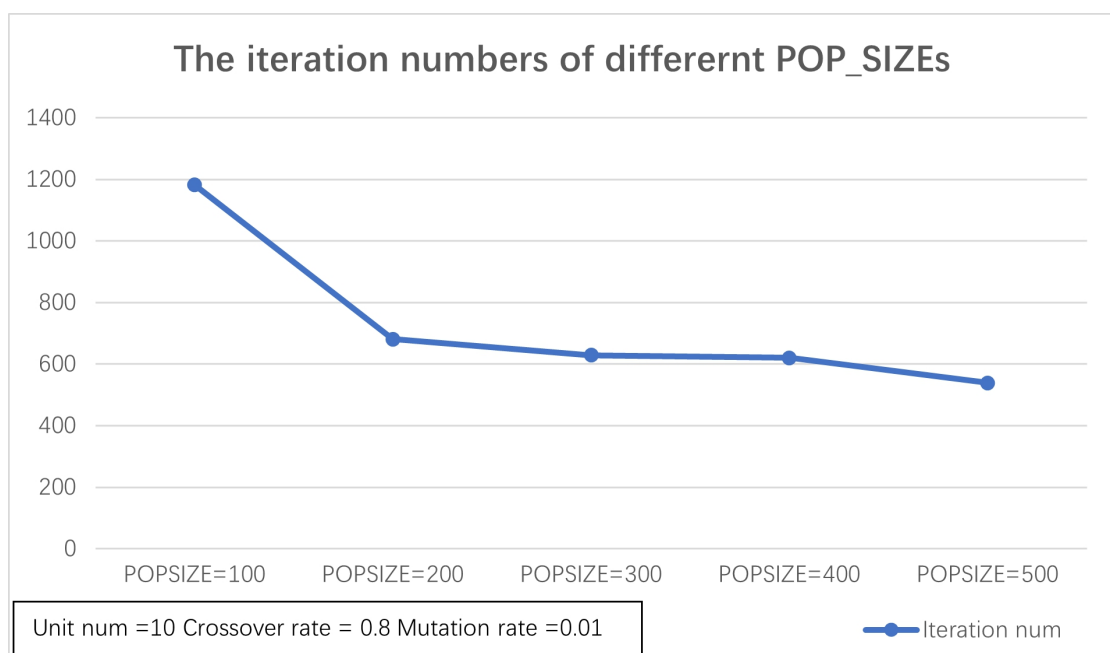
Figure 6

Change mutation rate

POPSIZE=150   Cross rate=0.8   unit number =10

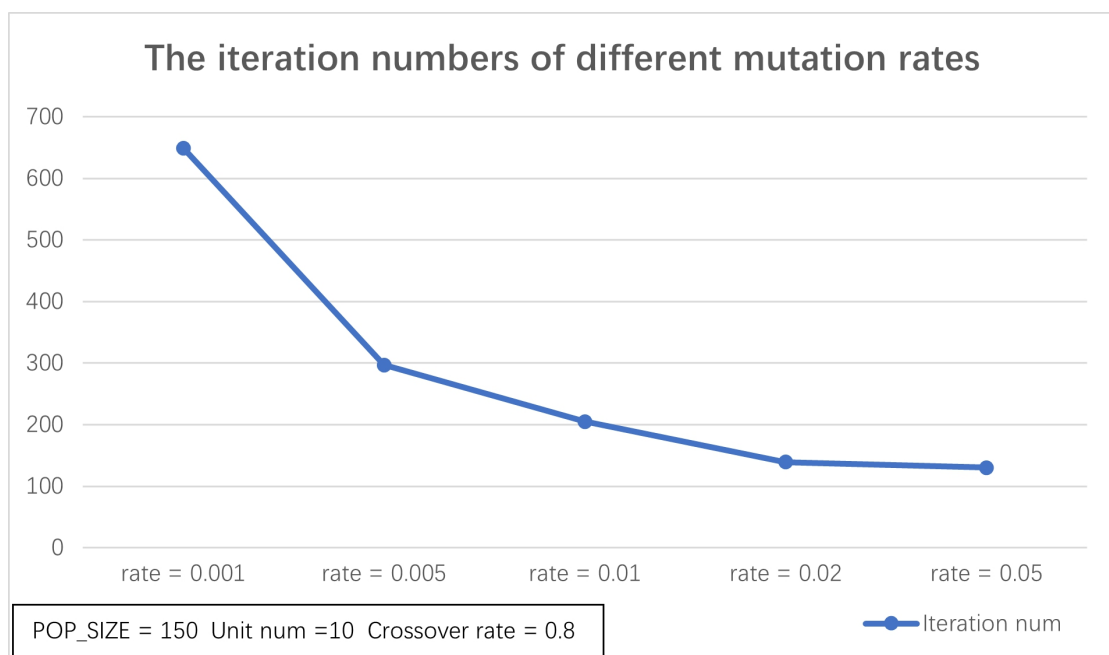|	Generation of convergence
Mutation rate=0.001	649
Mutation rate=0.005	297
Mutation rate=0.01	205
Mutation rate=0.02	139
Mutation rate=0.05	130

Figure 7

Change crossover rate

POPSIZE=150   mutation rate = 0.001 unit number =10

	Generation of convergence
crossover rate =0.8	838
crossover rate =0.85	749
crossover rate =0.9	742
crossover rate =0.95	778

The iteration numbers of different crossover rates
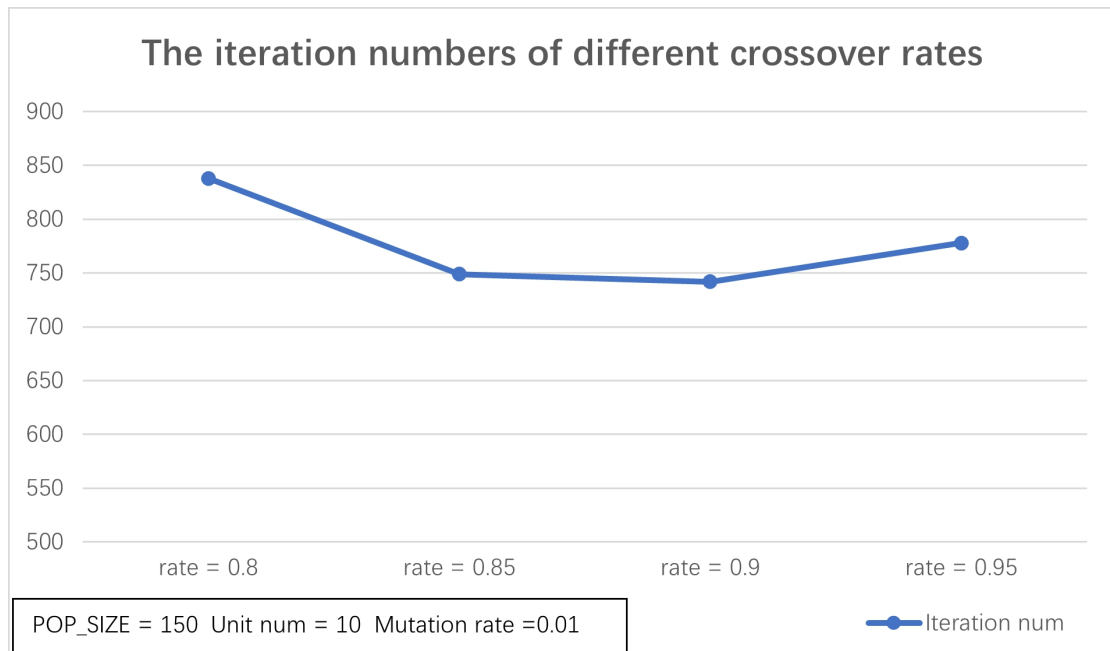
POP_SIZE = 150 Unit num = 10 Mutation rate =0.01

Figure 8

From figure 5, we can find that for unit number that equal to 5, its number of iterations are about 280. When unit number equals to 10, its number of iterations is about 650. After comparing these two results, it's easy to find that as the number of units increases, the algorithm needs more iterations to find the optimal solution. The reason for this is that the number of potential circuits increases with the size of the unit numbers, so the difficulty of finding the solution increases very rapidly with the size of the unit numbers. From figure 6 and 7, It's obvious to find that as either the Population size or mutation rate increases, the number of iterations decreases obviously, which means we can increase the speed of convergence by increasing the population size or mutation rate. As for figure 8, it seems to show the number of iterations has little to do with the crossover rate.

Therefore, in conclusion, the main parameters that affect the convergence speed and robustness of the genetic algorithm are unit numbers, population size and mutation rate.