

Figure 1 Plastic Glass

Table 1 Process parameters

Process parameters	Level	
	Low	High
Melt temperature (degree)	180	230
Mold Temperature (degree)	20	45
Filling Time (mm/s)	0.82	0.94
Packing Time (s)	5.88	7
Cooling Time (s)	14	18

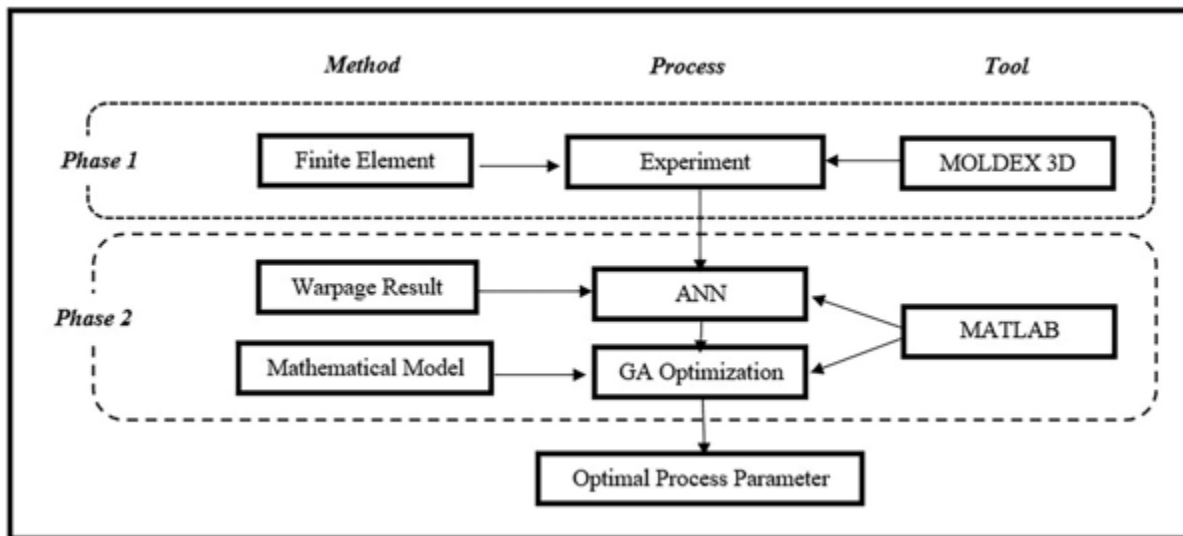


Figure 2 Process of paper

Table 2 Results of experiments simulation

No.	Melt Temperature	Mold Temperature	Filling Time	Packing Time	Cooling Time	Warpage
1	180	20	0.82	5.88	14	0.809
2	230	20	0.82	5.88	14	1.119
3	180	45	0.82	5.88	14	0.848
4	230	45	0.82	5.88	14	1.205
5	180	20	0.94	5.88	14	0.823
6	230	20	0.94	5.88	14	1.122
7	180	45	0.94	5.88	14	0.854
8	230	45	0.94	5.88	14	1.198
9	180	20	0.82	7	14	0.801
10	230	20	0.82	7	14	1.09
11	180	45	0.82	7	14	0.842
12	230	45	0.82	7	14	1.154
13	180	20	0.94	7	14	0.828
14	230	20	0.94	7	14	1.124
15	180	45	0.94	7	14	0.84
16	230	45	0.94	7	14	1.165
17	180	20	0.82	5.88	18	0.8
18	230	20	0.82	5.88	18	1.096
19	180	45	0.82	5.88	18	0.843
20	230	45	0.82	5.88	18	1.176
21	180	20	0.94	5.88	18	0.815
22	230	20	0.94	5.88	18	1.09
23	180	45	0.94	5.88	18	0.845
24	230	45	0.94	5.88	18	1.162
25	180	20	0.82	7	18	0.795
26	230	20	0.82	7	18	1.076
27	180	45	0.82	7	18	0.834
28	230	45	0.82	7	18	1.115
29	180	20	0.94	7	18	0.812
30	230	20	0.94	7	18	1.097
31	180	45	0.94	7	18	0.835
32	230	45	0.94	7	18	1.129

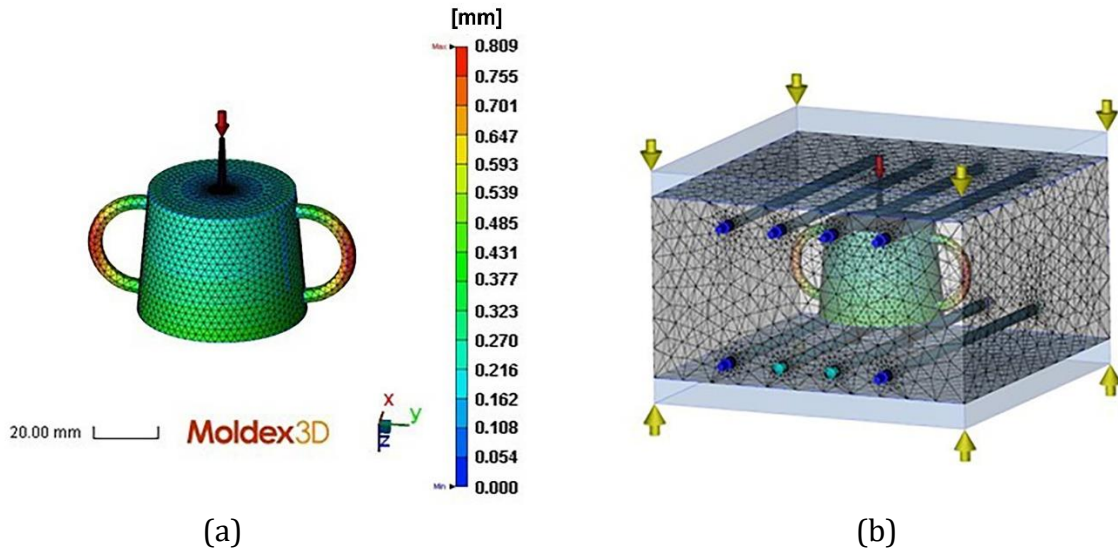


Figure 3 Simulation Analysis: (a) Warpage; and (b) Mold base

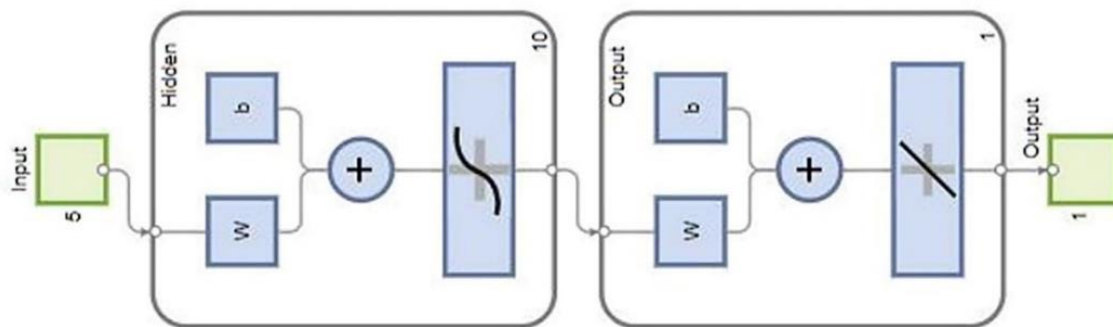
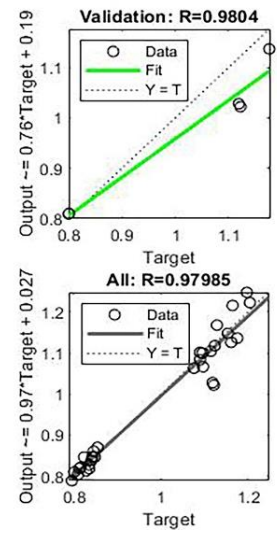
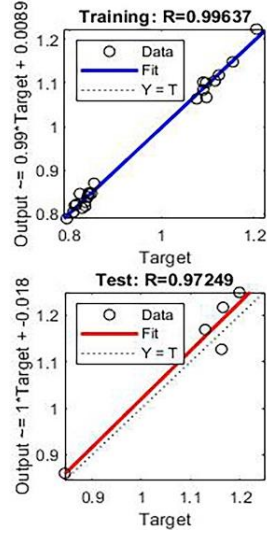
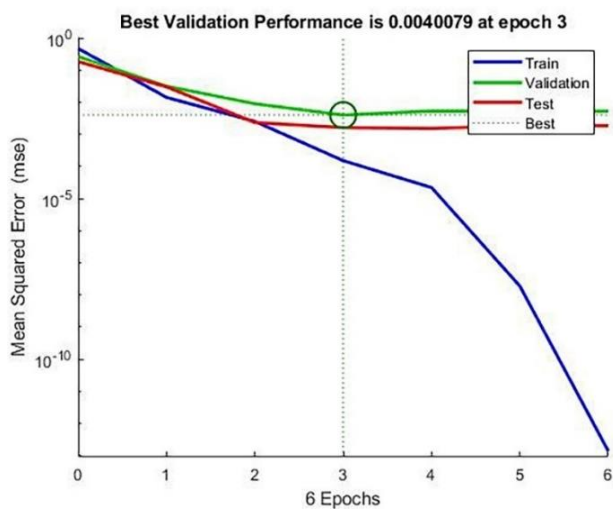


Figure 4 ANN Model

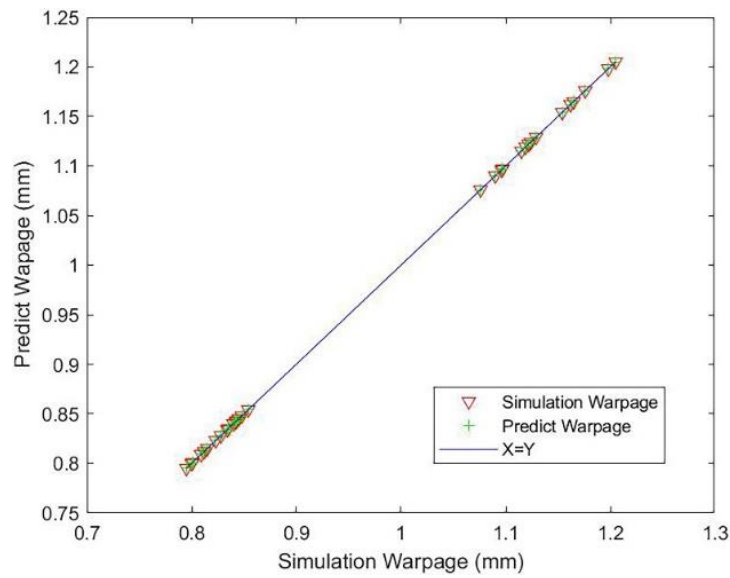
Table 3 Results of ANN prediction

No.	Melt Temperature	Mold Temperature	Filling Time	Packing Time	Cooling Time	Warpage	ANN Warpage
1	180	20	0.82	5.88	14	0.809	0.804
2	230	20	0.82	5.88	14	1.119	1.028
3	180	45	0.82	5.88	14	0.848	0.847
4	230	45	0.82	5.88	14	1.205	1.223
5	180	20	0.94	5.88	14	0.823	0.846
6	230	20	0.94	5.88	14	1.122	1.022
7	180	45	0.94	5.88	14	0.854	0.87
8	230	45	0.94	5.88	14	1.198	1.248
9	180	20	0.82	7	14	0.801	0.81
10	230	20	0.82	7	14	1.09	1.102
11	180	45	0.82	7	14	0.842	0.847
12	230	45	0.82	7	14	1.154	1.148
13	180	20	0.94	7	14	0.828	0.813
14	230	20	0.94	7	14	1.124	1.118
15	180	45	0.94	7	14	0.84	0.838
16	230	45	0.94	7	14	1.165	1.216
17	180	20	0.82	5.88	18	0.8	0.809
18	230	20	0.82	5.88	18	1.096	1.100
19	180	45	0.82	5.88	18	0.843	0.846
20	230	45	0.82	5.88	18	1.176	1.137
21	180	20	0.94	5.88	18	0.815	0.821
22	230	20	0.94	5.88	18	1.09	1.084
23	180	45	0.94	5.88	18	0.845	0.86
24	230	45	0.94	5.88	18	1.162	1.126
25	180	20	0.82	7	18	0.795	0.789
26	230	20	0.82	7	18	1.076	1.063
27	180	45	0.82	7	18	0.834	0.827
28	230	45	0.82	7	18	1.115	1.105
29	180	20	0.94	7	18	0.812	0.819
30	230	20	0.94	7	18	1.097	1.066
31	180	45	0.94	7	18	0.835	0.818
32	230	45	0.94	7	18	1.129	1.168



(a)

(b)



(c)

Figure 5 ANN Model performance: (a) Validation; (b) Overall data; and (c) Cross plot data

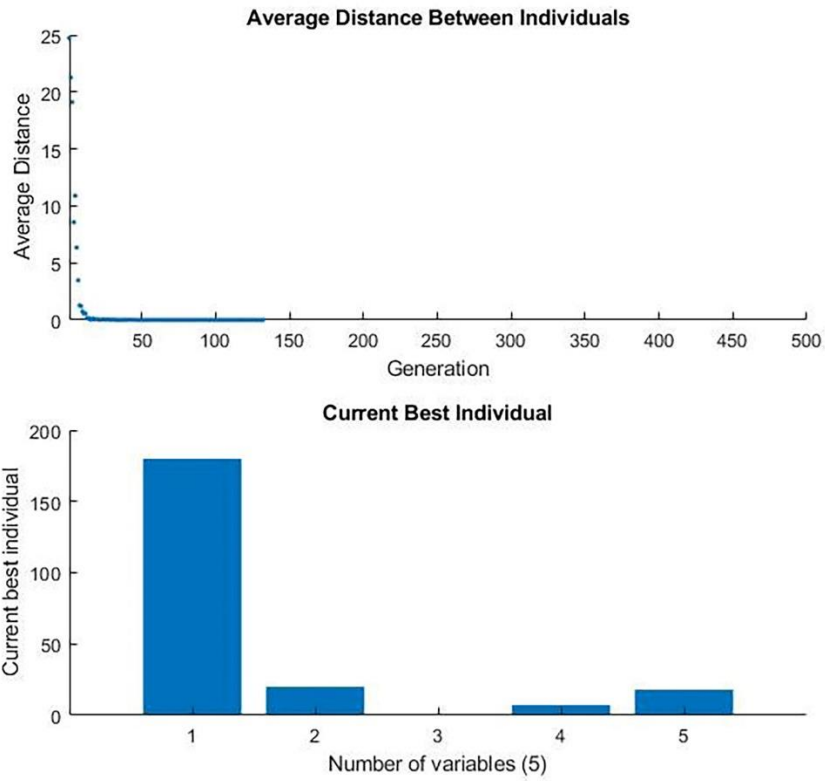


Figure 6 Result of GA optimization process parameter

Table 4 Process parameter of experiment simulation and GA

	Melt Temperature	Mold Temperature	Filling Time	Packing Time	Cooling Time	Warpage
Experiment Simulation	230	45	0.940	5.88	14	1.198
GA	192	23	0.865	6.72	16	0.770

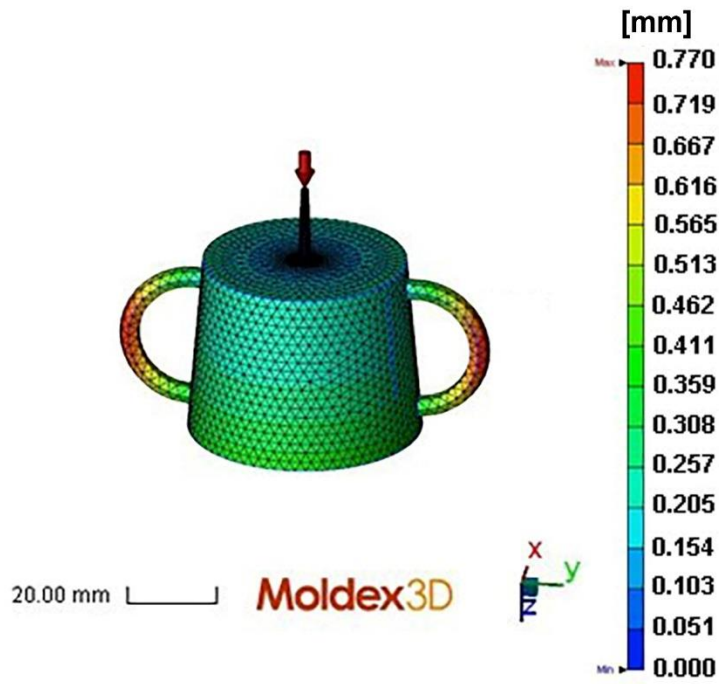


Figure 7 Confirmation optimal process parameters

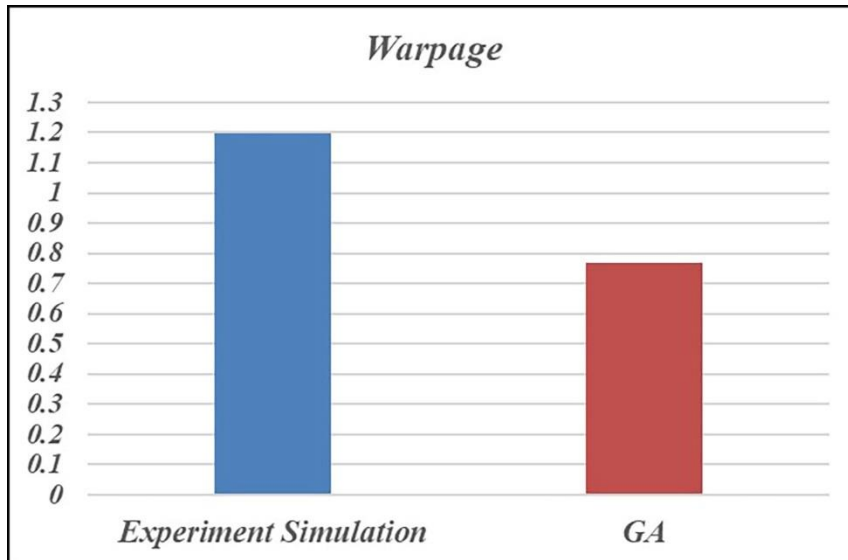


Figure 8 Result of GA optimization process parameter