TAB.3 PARAMETER OPTIMIZATION COMPARISON OF FUZZY CONTROLLERS AMONG CGA-PSO, GA AND PSO

Algorithms	α_1	α_2	α_3	*ke*	*kc*	*ku*	J (ITAE)
CGA-PSO	0.0389	0.4813	0.8193	6.3156	5.2938	4.4867	5.6318
PSO	0.0401	0.5133	0.8259	6.2628	4.9899	3.9983	9.0636
GA	0.3870	0.5775	0.8164	2.1517	0.2720	5.6736	26.2406

Figure 1 is shown that there is little difference with the performance of three controllers. After CGA-PSO optimization, the speed of the controller is faster and the overshoot is smaller. However, consider the optimization times of GA and PSO is five times of those of CGA-PSO, CGA-PSO has stronger searching capability and the convergence speed and optimization performance of CGA-PSO is significantly better than that of GA and PSO, which shows that there is greater value of CGA-PSO to promote. Figure 2 is shown that: For CGA-PSO, after CGA optimization ΔG times, we can get $\Delta ITAE / \Delta G = 8.0293 > \theta$. Continue to use CGA, after CGA optimization ΔG times, we can get $\Delta ITAE / \Delta G = 1.8668 > \theta$. Continue to use CGA, after CGA optimization ΔG times, we can get $\Delta ITAE / \Delta G = 0.0025 < \theta$. Switch to PSO, use PSO, after PSO optimization ΔG times, we can get $\Delta ITAE / \Delta G = 0.1390 > \theta$. Switch to PSO, Continue to use PSO, after PSO optimization ΔG times, stop the optimization.

We can see form the above results: Early in the algorithm run, it is relatively easy to optimize, when the ITAE index value drops significantly, which results in the algorithms can not switch in the first two rounds, enter into the irregular surface area to increase the difficulty of searching optimization, stop in the third round, and switch the algorithm at last.

V. CONCLUSIONS

A hybrid optimization algorithm based on chaos GA combined with PSO is proposed in the paper. The experiment results show that the optimization ability of proposed algorithm is obviously superior to the single one. However, since the algorithm combines the chaotic mechanism, the algorithm traversing capabilities are improved, but it depends on the initial values at the same time. How to improve the robustness of the algorithm, is the next research we need to study.

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