

## Design of Robust Systems using Competitive Co-evolution

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Recently, material-handling systems with Automated Guided Vehicles (AGVs) are being used in manufacturing factories. These programmable AGVs circulate on a guide-path and transport materials in factories (Fig.1). Design process of robust AGV systems is proposed in this research. One of the important design problems associated with the development of AGV systems is a flow-path network design problem.

When the task changes to another task, the flow-path network should be designed again from the beginning in previous works. The flexibility is one of the strong merits in AGV system. Therefore, the robust AGV system is the more efficient transportation system than other systems. However, for this robust flow-path, the number of possible tasks is very large in AGV systems, therefore it is impossible to test the promising flow-path network against all of possible tasks.

The problem is solved by the method of difficult task design with Genetic Algorithm (GA) and an effective flow-path network is designed with GA simultaneously, because the difficult tasks depend on the flow-path networks. Both the network and the task evolve competitively as in Fig2 and a robust network and difficult tasks are finally designed. The robust network means that the minimum number of conveyance is large with the network to some tasks.

Results of the designing are shown through AGV transportation simulations (Fig.3) and the designed flow-path network (Fig.4) makes it possible to complete 10000 tasks that are generated randomly. This shows that the network is robust against tasks and our method is effective.

*Keywords:* Competitive Co-evolution, AGV Transportation System, Flow-path Network Design

### References

- 1) R. Chiba, J. Ota, and T. Arai, "Design of Robust Flow-path Network for AGV Systems using Competitive Co-evolution with Packaging," Proc. of IROS2005, pp. 3164-3169, 2005.

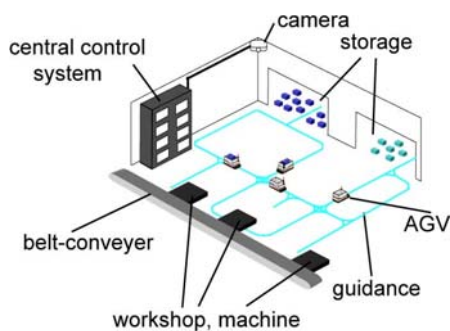


Fig. 1 AGV Transportation Systems

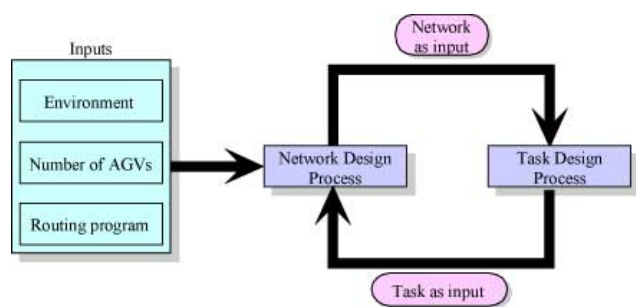


Fig. 2 Design Process with Co-evolution

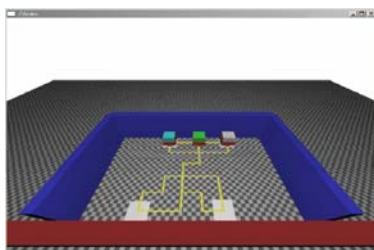


Fig. 3 Simulation for AGV Systems Design

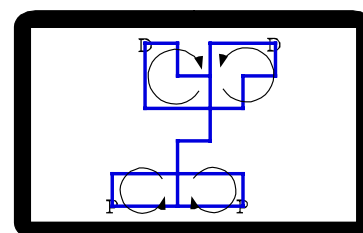


Fig. 4 Designed Network and AGV behaviors