GENETIC FUZZY LOGIC APPROACH TO LOCAL RAMP METERING CONTROL USING MICROSCOPIC TRAFFIC SIMULATION

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Abstract

Ramp metering, one of the most effective solutions for improving motorway traffic flows, is playing increasingly important role in traffic management systems. Because of its capability to handle nonlinear and non-stationary problems, fuzzy logic based ramp metering algorithms have been always considered as an extremely suitable control measures to handle a complex nonlinear traffic system. This thesis proposes a genetic fuzzy approach to design a traffic-responsive ramp control algorithm for an isolated on-ramp. For a local ramp meter algorithm, the problem could be described as the inflow optimization of on-ramp, based on the evaluation of motorway traffic condition. If the inflow of on-ramp is considered as the decision variable, the ramp control problem could be treated as a nonlinear optimization problem of maximizing the evaluation function. The adaptive genetic fuzzy approach is actually a control approach to maximize the inflow of on-ramp under the restriction of evaluation function.

In this thesis, a well-known fuzzy logic based ramp metering algorithms developed by Bogenberger is introduced and implemented with an on-ramp congestion model of Constellation Drive Interchange in a stochastic microscopic traffic simulator, Aimsun. To improve the performance of fuzzy control system, genetic algorithm is applied to tune the parameterized membership function of each fuzzy input to maintain the flow density of motorway blow the estimated congestion density. The performances of the genetic fuzzy logic control ramp metering are compared with FLC (fuzzy logic control) ramp metering by means of the percentage change of TTT (Total Travel Time) based on no control condition in Aimsun. The simulation results show the genetic fuzzy ramp metering has a more significant improvement on TTT and more strong stability to maintain system flow density than FLC ramp metering.

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