Autonomous Decentralized Control of Traffic Signal Network

(Dr. M. SUGI, Prof. J. OTA and Prof. T. ARAI)

Growing number of automobiles deteriorates traffic conditions and brings forth increased congestion and more frequent accidents. The control of traffic signals has been researched as one of the countermeasures to improve such situations.

The conventional signal control method is based on off-line planning with centralized control scheme. However, this method cannot follow dynamic changes of traffic volume, nor unexpected traffic conditions caused by road constructions or accidents. Its centralized architecture also makes it difficult to cover wide area.

We have proposed a new method for controlling a large number of traffic signals in a decentralized manner. Traffic signals forming a network are modeled as a nonlinear coupled oscillator system. The behavior of each oscillator is governed by a reaction-diffusion equation on a graph. Each signal determines its split (ratio of the green light for each direction), offset (difference between the onset times of green lights of the neighboring signals), and cycle length (period of the signals) from its local traffic conditions. Therefore this method enables to handle a wide area with dynamic environments effectively.

We tested the present method by simulations on a square road network with straight traffic flow (i.e. no turning to left nor right). The results have shown high stability in a stationary environments and a high adaptability in dynamic environments.

As a future work, we will test the present method applying actual traffic data observed at existing urban road network.

Keywords: Traffic Signal Control, Nonlinear Coupled Oscillator System, Reaction-Diffusion Equation on a Graph

References

1) Masao Sugi, Hideo Yuasa and Tamio Arai: “Autonomous distributed control of traffic signal network,” Intelligent Autonomous Systems 7 (IAS-7), IOS Press, pp. 317~324, 2002.

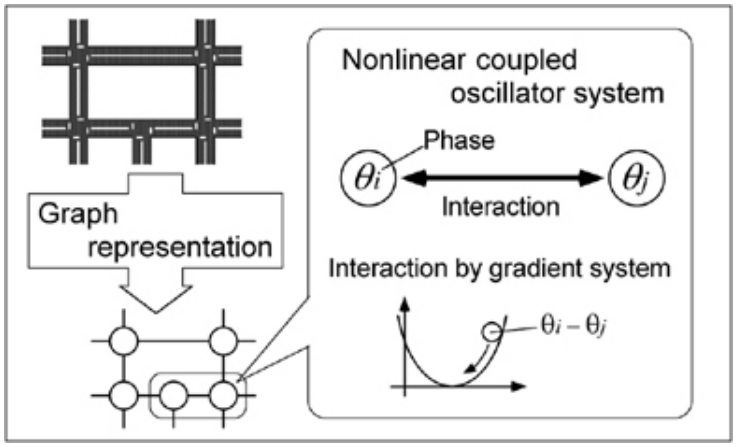

Fig. 1 Overview of Present method

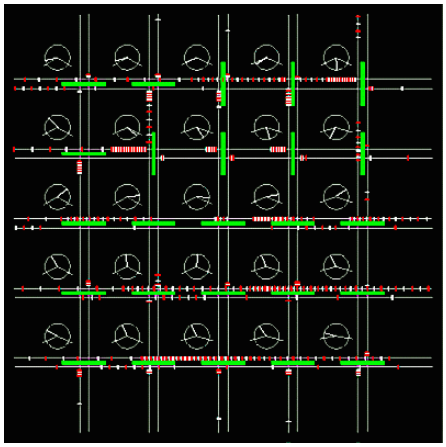

Fig. 2 Traffic Simulator