Organic Traffic Control (OTC)

DFG SPP 1183 Organic Computing (www.aifb.uni-karlsruhe.de/EffAlg/Projekt/otcqe)

A research cooperation between the Institute of Applied Informatics and Formal Description Methods, Karlsruhe Institute of Technology (KIT), and the Institute of Systems Engineering – System- und Rechnerarchitektur, Leibniz Universität Hannover.

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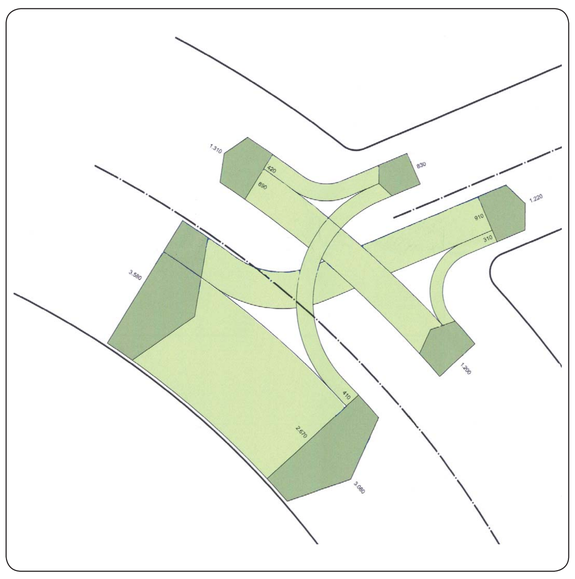
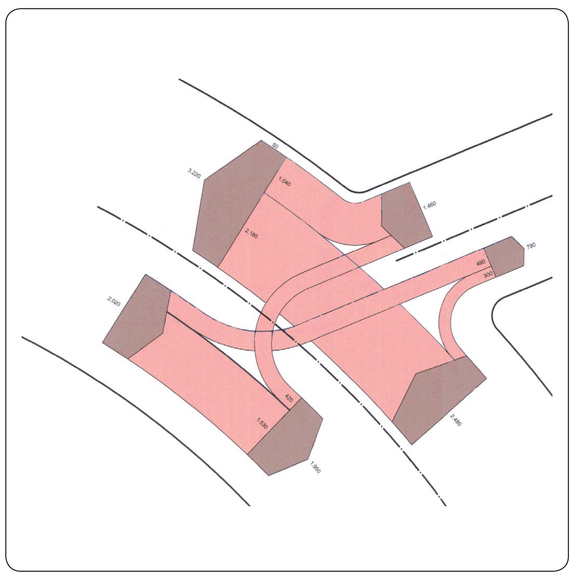
Changing traffic situations...

...at node level

- Traffic situations are constantly changing.
- Identification of situations by measurement of traffic flows
- Goal of controller: Adapt to changes





Different traffic situations at an intersection in Hamburg (data from a traffic census). Arrow width proportional to traffic flows.

Changing traffic situations...

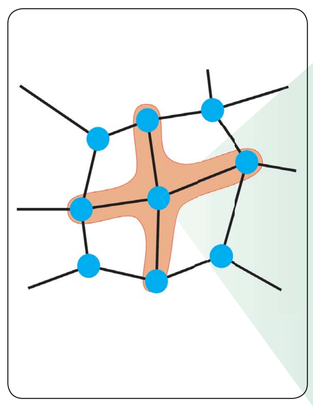
...at network level

- Local control strategies need to support global goal.
- Global optimisation requires communication and cooperation between nodes. ➜ Controllers act like agents.
- ➜ Emergence likely to occur when using decentralised optimisation approach, Organic Computing techniques useful for this task

Experimental setup

Studies are based on a road network with signaled inter-sections:

- Intersections are equipped with traffic light controllers that adjust signal timings depending on local traffic information.
- Controllers at neighbouring intersections cooperate to improve the network-wide traffic situation.



Benefits of the Organic Approach

- ➜ Existing industry-standard controllers can be integrated.
- ➜ The system responds autonomously to changing traffic situations.
- ➜ New parameter sets can be generated automatically.

Goals of this project

- Develop a generic controller, minimise necessary adjustments to different traffic networks
- Controller reacts on changing traffic situations autonomously.
- Reliability, safe operation
- Quick response to changes
- ➜ Requirements lead to multi-layer architecture.

Multi-layer architecture

Layer 2: Generating parameter sets

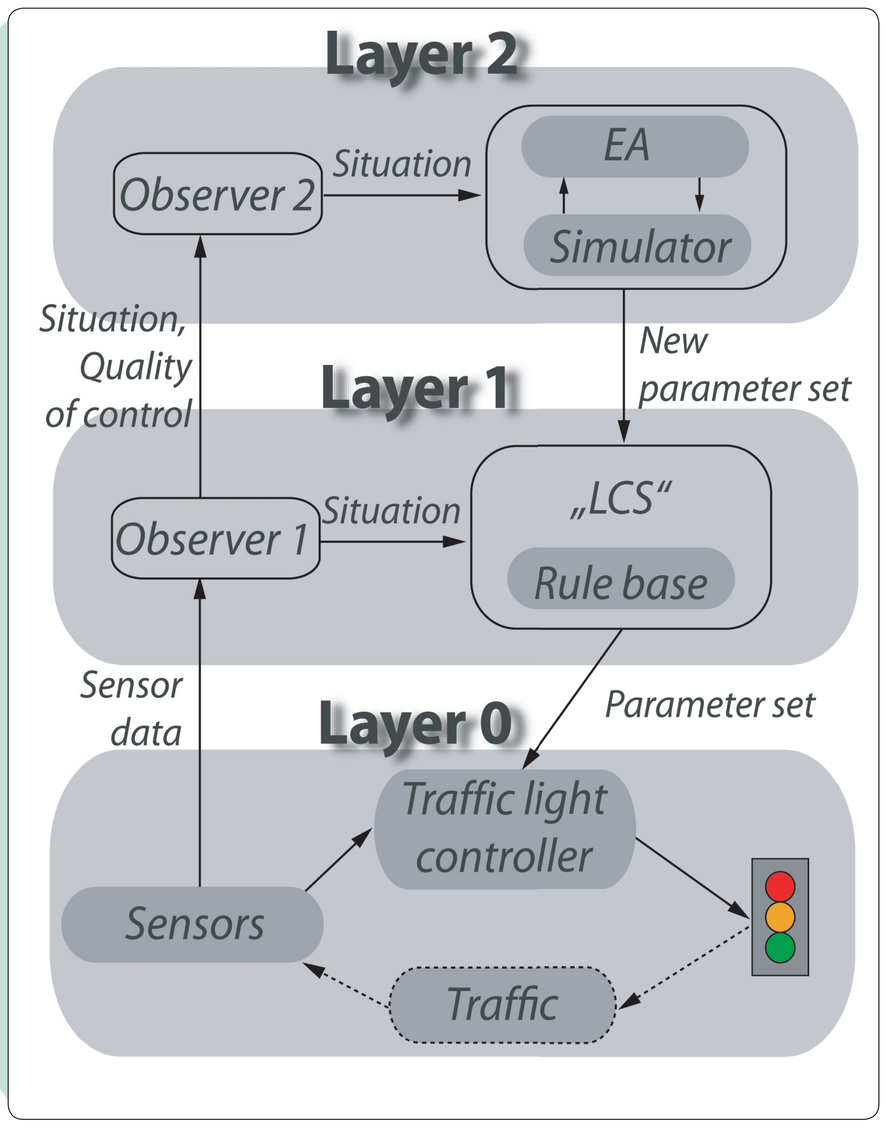
Control parameter sets are generated by an Evolutionary Algorithm (EA). Their quality for a specific situation is evaluated using a traffic simulation software.

Layer 1: Selecting parameter sets

Larger changes in traffic require changes in the parameter set.
An observer recognises the traffic situation and a modified Learning Classifier System (LCS) selects an appropriate parameter set from its rule base.

Layer 0: Controlling the traffic lights

A traffic-responsive controller reacts on small changes in traffic. Its behaviour is determined by a set of parameters.



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