QI-TraSiCo

Quantum-Inspired Traffic Signal Control

QI-TraSiCo aims to use novel, quantum-inspired computing technology to optimise traffic signal control across a road network - in real time. This demonstrates the practical usability and added value of quantum computing for real-time applications in the field of traffic control.

- Applications
- Optimisation

1. Motivation

The volume of traffic on our roads is constantly increasing, resulting in growing traffic jams, waiting times and environmental pollution. An expansion of the road infrastructure is often not feasible, which is why optimising traffic control is a preferred option to cope with these problems.

The efficiency of traffic signal control has major influence on traffic quality. In large cities with a high number of traffic signals optimisation is a challenge, especially in real time. Present traffic control centres have reached their limits. The future application of powerful quantum computing offers completely new opportunities.

2. Traffic signal control system

The aim of the QI-TraSiCo project is to use innovative, quantum-inspired computing technology and algorithms to optimise traffic signal control in real time. The application of quantum computing in the field of traffic signal control has hardly been tested in practice so far. Due to long life cycles, today's transport infrastructure is not yet compatible with

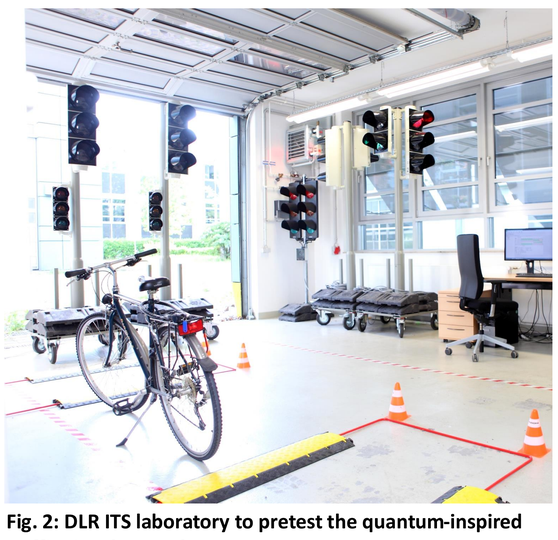

Fig. 2: DLR ITS laboratory to pretest the quantum-inspired traffic signal control system

innovative quantum computing solutions. Missing interfaces to quantum computing must be implemented and reliable 24/7 operation has to be ensured for reliable live traffic control on the road. A network control algorithm needs to be set up that fully utilises the potential of quantum computing while also complying with legal and safety requirements.

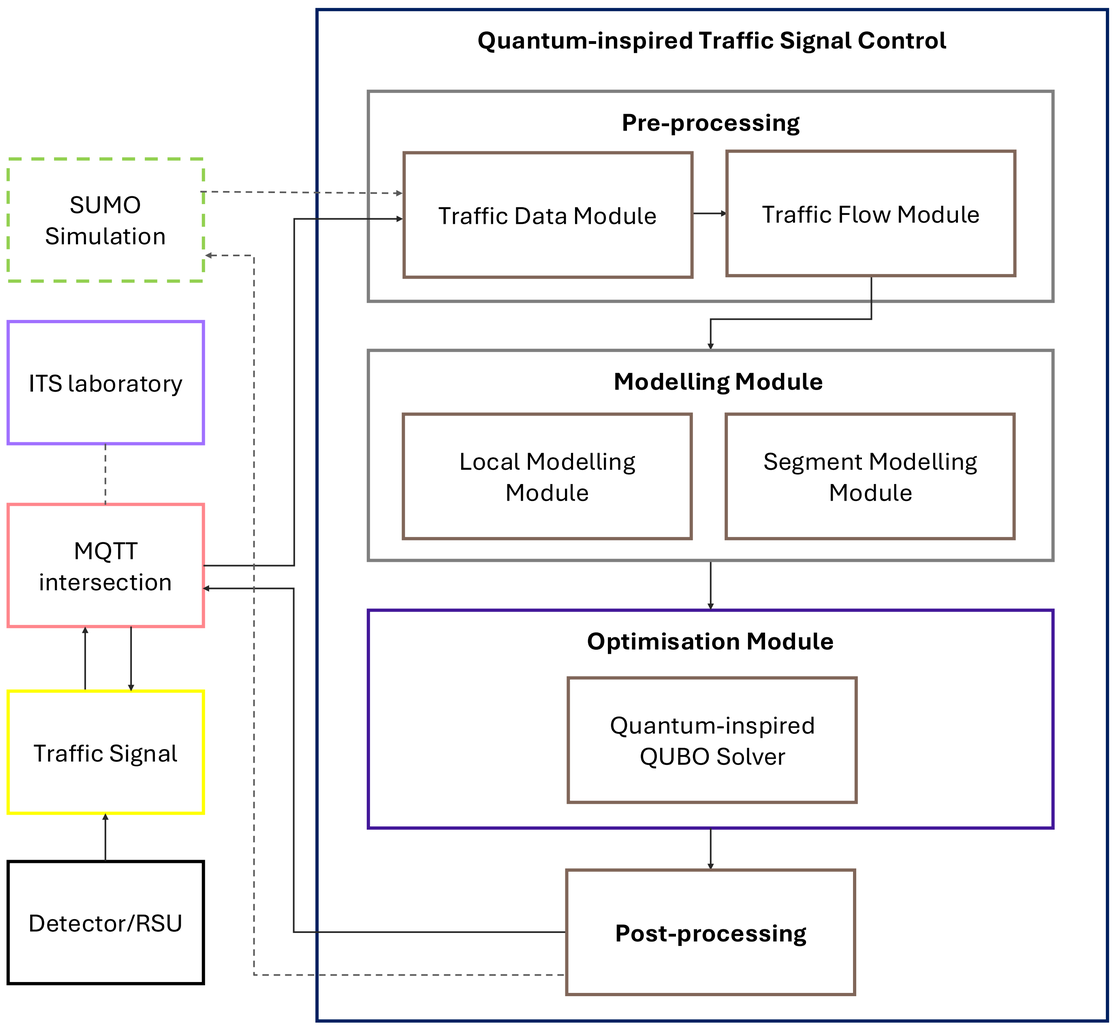

Fig. 1: Architecture and components of the quantum-inspired traffic signal control system

3. System architecture and components

The quantum-inspired traffic signal control system is based on a modular architecture and comprises several components and modules.

The traffic module is used for preprocessing and consists of two sub-modules. In the traffic data module, the incoming traffic data is aggregated, checked for plausibility and completeness and corrected if necessary. Based on this, the traffic flow model creates a temporal-spatial simulation of the traffic flow.

Decisions on traffic signal control are made in a dedicated optimisation module, which involves three sub-modules. In the local level module, the degree of traffic flow saturation and the green time allocation are determined. The route-related level module coordinates offset times between neighbouring intersections, which is important in terms of a green wave. The optimisation problem is formalised as a QUBO model and solved by a hybrid engine which is based on two computational models, Parallel Tempering (PT) and Simulated Quantum Annealing (SQA).

4. Implementation environment

The quantum-inspired traffic control system is first tested in a simulation study using the microscopic traffic simulation software SUMO (Simulation of Urban Mobility). The aim of the simulation study is to initialise parameters for certain sub-modules and to gradually improve the system towards the best initial configuration.

In different simulation scenarios, the system is intended to optimise the overall traffic flow, but also enable priority to be given to cycle traffic and emergency vehicles.

To prepare the quantum-inspired traffic control system for use on the real road, it is also being tested in the DLR ITS laboratory. The DLR ITS laboratory provides traffic technology and technical equipment that are also applied at real-world road intersections. This includes, in particular, several traffic signal control units. The interaction between the quantum-inspired control system and real traffic technology can thus be verified and adjusted for the roll-out in a test field.

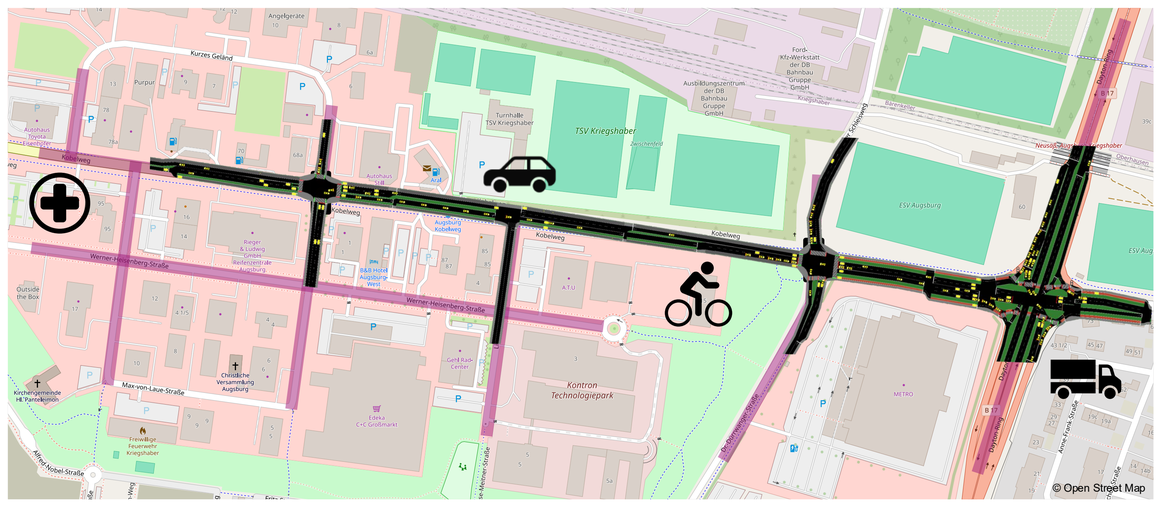

Fig. 3: Real test field in the German city of Augsburg with overlaid SUMO simulation model

5. Real test field and evaluation

The quantum-inspired control system will be applied to a real road section in the German city of Augsburg. The chosen road section serves as an arterial to the city centre, major cycle route and access link to a hospital. Congestion regularly occurs here, especially during rush hours. The existing traffic infrastructure will be connected to the quantum-inspired control system.

Field data from trail periods will be recorded and analysed to evaluate the system's performance. Findings are presented at a final public event to promote future application of quantum computing in traffic signal control.

Fig. 4: Intersection control unit to be integrated into the quantum-inspired control system

You can more information about the project on our website:

A project of

DLR Institute of Transportation Systems

Contractors

BearingPoint · MULTIVERSE COMPUTING · Fraunhofer CML · gevas humberg & partner · moderne Straßenverkehrstechnik Stührenberg

Contact

Robert Oertel
robert.oertel@dlr.de

Elisabeth Wagner
elisabeth.wagner@bearingpoint.com

Oliver Szal
oliver.szal@fraunhofer.cml.com

DLR | QCi

Get in touch.
We enable quantum!