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. Thereby DLR demonstrates the practical usability of quantum computing for real-time applications in the field of traffic optimisation and control that already exists today.

- Applications
- Optimisation

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 the main option to cope with these problems.

The efficiency of traffic signal control has a great 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 computers offers completely new opportunities.

Objective

The aim of the QI-TraSiCo project is to use innovative, quantum-inspired computing technology to optimise traffic signal control in real time. In a prototypic implementation, several traffic signals of a real test field are connected with a quantum-inspired system and optimally controlled.

Fig. 1: Traffic signal applied to increase traffic safety and efficiency

Traffic signal control system

The application of quantum computing in the field of traffic signal control has hardly been tested in practice so far. Additionally, today's transport infrastructure is not yet compatible with innovative quantum computing solutions and often has very long life cycles. Thus interfaces to new applications such as quantum computing do not exist and need to be developed and implemented first.

Reliable 24/7 operation has to be ensured to prevent failures in live traffic signal control on the road. A network control algorithm must be set up that fully utilises the potential of quantum computing while also complying with legal requirements, such as safety-relevant clearance times or maximum permitted green times.

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

Simulation and testing in the laboratory

The quantum-inspired traffic control system is first tested in a simulation study. For this purpose, the quantum-inspired system is coupled with a microscopic traffic simulation. The DLR traffic simulation SUMO could be used here, for example. In different simulation scenarios, the quantum-inspired system controls the traffic signals of the future test field. The control system can thus be optimised step by step.

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 all traffic technology and technical equipment that are also applied at typical road intersections. These include, in particular, traffic signal control units. The interaction between the quantum-inspired control system and real traffic technology can thus be verified and optimised for the roll-out in the test field.

Search for industrial partner

An industrial partner is to be involved in the project as part of a tender that is due to start soon. This partner is to provide a system consisting of quantum-inspired hardware resources and a traffic control system executed on them.

In addition to experience in quantum computing and software development, know-how in traffic signal systems and their modes of operation are important for successful field implementation.

Real test field

The quantum-inspired traffic signal control is going to be trialled in a real test field. A road section in the German city of Augsburg, which has already been used in another DLR project, is utilised for this purpose. The route is an entry and exit road to the city centre, cycle route and access route to a hospital. Congestion regularly occurs here, especially during rush hours.

To avoid these traffic jams and to ensure road safety, traffic signals are applied at three intersections along the route. These traffic signals are intended to increase traffic flow by creating a green wave. Several traffic detectors at each intersection serve the traffic signals with data for their switching decisions.

Up to now, conventional signal control methods have been applied for green time allocation, which can only make local decisions as they are not designed for network-wide real time optimisation.

Implementation and proof of concept

The quantum-inspired control system will be implemented in the test field in Augsburg. The existing traffic infrastructure will be connected to the quantum-inspired system. This requires some adjustments to be made to the traffic signals.

The traffic signals must transmit detection and status information to the quantum-inspired network control system. In return, instructions for optimised green time allocation are received and processed. In addition to optimising the overall traffic situation, the aim is to implement bicycle and emergency vehicle prioritisation.

During the test runs as part of the proof of concept, field data will be collected to analyse the overall system and evaluate its performance. Findings will be presented to interested local authorities and infrastructure operators to promote the future application of quantum computing in the field of traffic signal control.

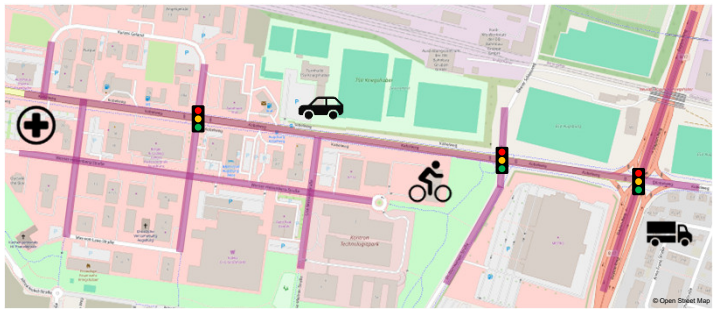

Fig. 3: Real test field in the German city of Augsburg

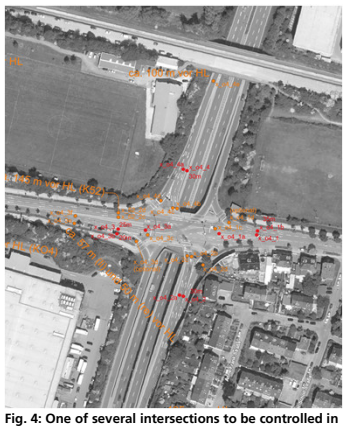

Fig. 4: One of several intersections to be controlled in the real test field

Fig. 5: Intersection control unit to be integrated into the quantum-inspired control system

More information about the project on our website

A project of

DLR Institute of Transportation Systems

Contractor

To be involved by a tender starting soon!

Contact

Dr. Robert Oertel
robert.oertel@dlr.de
+49 30 670 55 650

Kim Jannik Eggers
kim.eggers@dlr.de
+49 531 295 2113

DLR | QCi

Get in touch.
We enable quantum!

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag