GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN IN PUBLICA COMMODA SEIT 1737

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Traffic Light Optimization

Urban traffic congestion leads to increased travel time, higher fuel consumption, and greater CO_2 emissions, making it a critical challenge for sustainable cities and communities. One key factor contributing to inefficiency is suboptimal traffic light timing, which often fails to adapt to dynamic traffic conditions. This project addresses the problem of optimizing traffic light control at urban intersections to reduce waiting times and improve traffic flow. This work contributes to the United Nations Sustainable Development Goals, specifically Sustainable Cities and Communities, Industry, Innovation and Infrastructure, and Climate Action, by improving urban mobility and reducing emissions. Furthermore, improved traffic flow may indirectly benefit logistics operations by reducing delays for delivery vehicles and freight transport, such as delivery vehicles transporting goods between suppliers, manufacturers, and customers.

To tackle this problem, we propose the use of evolutionary computation, specifically Genetic Algorithms, to optimize traffic signal timing. The approach models traffic light phases as candidate solutions and iteratively improves them using selection, crossover, and mutation based on a defined fitness function, such as minimizing average waiting time. A simplified simulation environment will be used to evaluate different timing strategies under varying traffic scenarios, including high congestion (e.g., rush hour) and low traffic conditions.

We expect that the optimized solutions will reduce congestion and improve traffic efficiency compared to fixed-time control systems. These results could contribute to more sustainable urban mobility by lowering emissions, enhancing transportation efficiency, and supporting more reliable and efficient logistics processes.