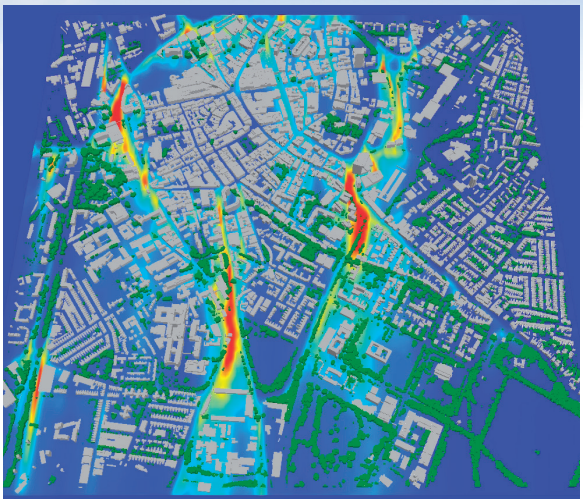
Urban traffic management and air quality project



▲ Dispersion of roadside pollution in Leicester city centre as predicted by dispersion model. Here the buildings and trees are impacting the venting and tend to trap pollution in street canyons (high concentration in red and low concentration in blue) © University of Leicester

The Urban Traffic Management and Air Quality project (uTRAQ) is a European Space Agency demonstration project developed under the Advanced Research in Telecommunications Integrated Applications 20 Programme. TRL is leading the uTRAQ project, which will lay the groundwork for a new system that uses traffic and air quality data modelling to predict traffic flow scenarios based on transport patterns, traffic management regimes, and emission profiles. uTRAQ aims to:

- Demonstrate and promote how space applications can be used for the management of traffic and air quality;
- Provide city-wide data for traffic and air quality for the support of policy decisions at an operational level;
- Develop a new operational service in close participation with local authorities for managing their traffic and air quality through broad participation by key factors such as local authorities, SMEs, and other industrial businesses;
- Demonstrate a manual/automatic monitoring and decision support tool to aid traffic management tools at an operational level, considering a range of policy level objectives.

uTRAQ is a collection of integrated software components that enhance an existing UTC system, in this case SCOOT, to optimise traffic signal timings for both improved air quality and traffic flow, instead of just for optimal traffic flow.

uTRAQ's modular approach integrates data sources both known (traffic data) and new (air quality, meteorological data) to a traffic management system. Each module serves a specific purpose and is used in the collection, filtering, processing and analysis of the various data feeds in the coordination of the following process:

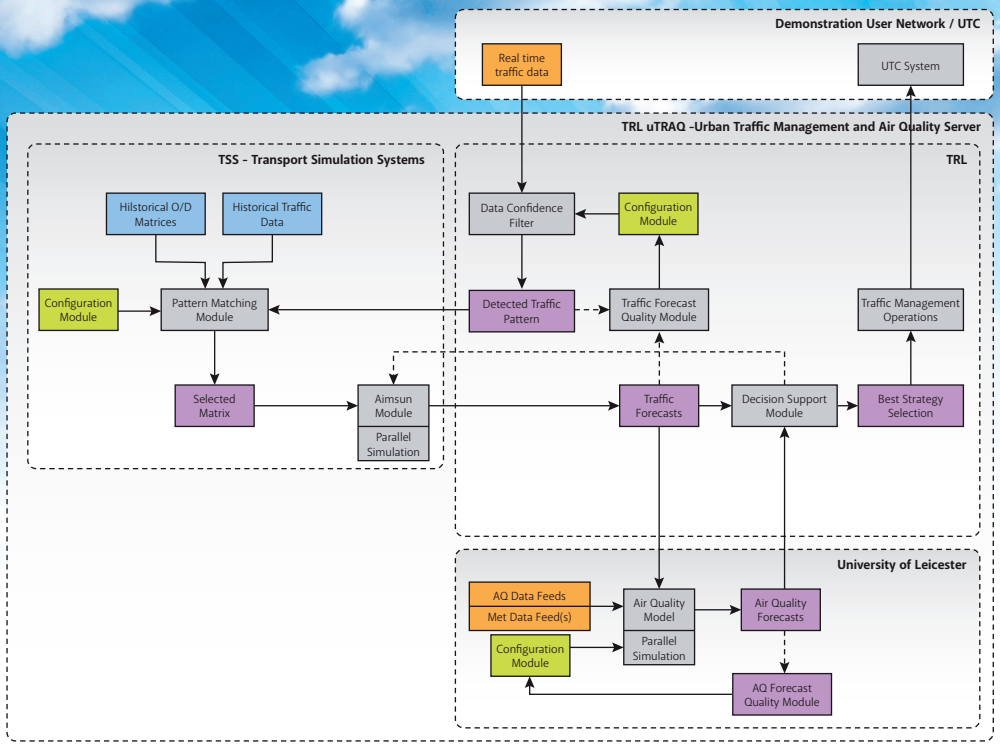
1. Calculation of potentially beneficial traffic control strategies (in addition to the likely outcome of the 'do-nothing' scenario);
2. Simulation of these strategies using traffic and air quality modelling;
3. Identification of an optimal strategy, based on local policy, performance measures and user interaction; and
4. Passing the optimal strategy to the existing UTC system for implementation on street.
5. On-going internal validation of the system outputs to ensure convergence between modelled and real world data.

Air quality and traffic management strategies are generated through the use of simulation models. Unlike older traffic simulation models such as SATURN, Aimsun is able to deal with very large networks in a short time; in fact it is so fast it can simulate whole cities in 2-3 minutes, or near real time. See Figure 1 for the overall system architecture.

The University of Leicester is building the air quality (AQ) module, which identifies the AQ data feeds: real world forecasts, 'now-casts' and the emissions profiles created from the traffic model for each strategy. This combination of feeds will enable uTRAQ to identify points, routes or areas where AQ is a problem, based on the measured air quality; where it could be a problem, based on traffic model forecast; and finally the outcome of a 'do-nothing' scenario. The performance indices (PI) are user-defined metrics, based on traffic and air quality. In the case of journey time / predictable and consistent journeys, the PI will provide feedback on strategy, comparing current traffic operation and current air quality and if the strategy is expected to improve or worsen the real world situation.

Air quality forecasts for a given urban area need to account for traffic emissions, local non-traffic sources, and regionally imported pollution. The regional import of pollution is a challenge to estimate, being dependent upon complex meteorology and emission profiles. Earth Observation data is required to assess regional meteorology and atmospheric composition. For the uTRAQ architecture, the MACC service is used to assimilate a substantial number of data products, including wind-vectors, temperature, pressure, and ozone. Assimilated data is then used to model the dynamics and chemistry of atmospheric composition and deliver a surface-level concentration of pollutants, particularly nitrogen dioxide. For many medium-sized cities and towns, the proportion of imported pollution can be a substantial contribution to regulatory levels, and therefore local abatement strategies need to adapt rapidly to external influences. As such, the background pollution

By Christopher Kettell, TRL; Mark Brackstone, Jordi Casas and Josep Maria Aymami, TSS–Transport Simulation Systems; Roland Leigh, Ed Lamb and Antoine Jeanjean, University of Leicester



▲ uTRAQ system architecture. Aimsun traffic modelling software is developed and supported by TSS-Transport Simulation Systems.

import information gained from Earth Observation data, through the MACC service, is invaluable.

As part of the decision support module, being developed by TRL (in the top right of Figure 1), the user will be able to define the local priorities when identifying strategies and then test the strategies to identify the optimal solution. The uTRAQ system recommends an optimal strategy to use but shows the user possible alternatives – this is the key operational principal of the decision support module.

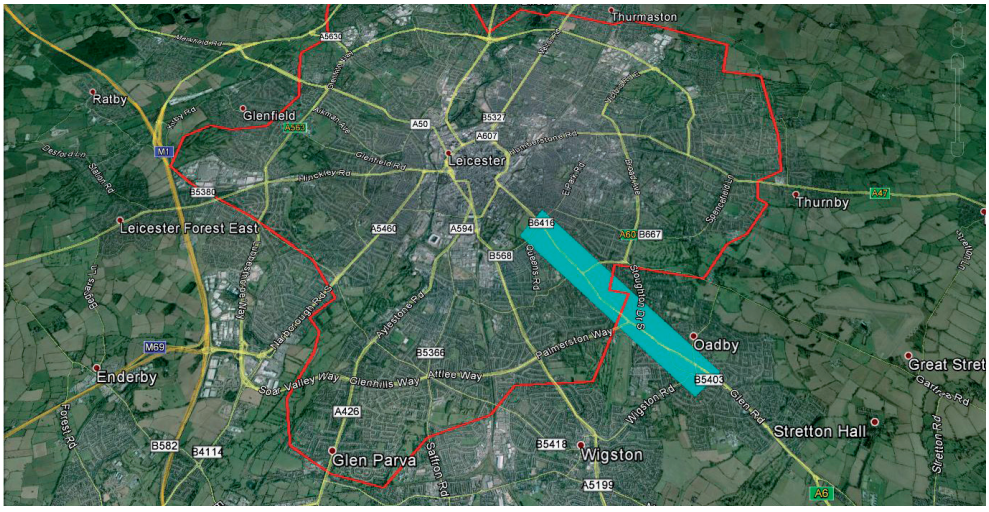
A key differentiator from earlier efforts in this field is the direct interaction between the traffic model and the existing SCOOT network: the current state of the network will be the starting point of any traffic simulation and scenario testing in conjunction with the air quality model with a rapid turnaround time.

The existing UTC system retains overall control of the traffic control infrastructure, continuing with its second-by-second optimisation, and receives higher-level strategy recommendations from the uTRAQ system, which will influence longer-term optimisation trends; this also ensures a failsafe situation in the event of a system failure or loss of connection to the service. Differentiating uTRAQ from the previous iterations is full UTC integration. In the demonstration project, the system will run in a live environment, operating under supervision, where the traffic management operator is advised of a strategy, which can then be manually entered into the UTC, via the Common Database; alternatively uTRAQ can push the strategy to the Common Database with minimal user intervention. In short, the demonstration will be capable of operating in a supervised or fully autonomous manner, providing strategies to the UTC system that will directly affect its optimisation calculations, and thus taking effect on-street.

Three Demonstration Sites

Over the course of the next year, the uTRAQ system is due to be implemented and tested at three locations, each one testing the system on a larger scale. The first of these is through Leicestershire County Council and involves the A6 corridor (London Road) from Ashtree Road in Oadby at the southern end to the Victoria Park roundabout at the northern end, which is just inside the city boundary. The A6 approaches the city from the south east and is considered to be one of the busiest stretches of road in the county. Significantly, the main Leicester ring road crosses this route and it also receives a large number of minor tributary roads. With the assistance of Leicester City Council, the systems will later roll out to include most of the City and some adjacent sites in the County including up to 122 controlled junctions, most of which have SCOOT. Lastly a demonstration in Northampton will include up to 66 road junctions, most of which have SCOOT.

With air quality and traffic management considered high priority policy issues for both central government and local authorities, the future is bright for further development of the uTRAQ approach. As local authorities are reluctant to replace existing air quality or traffic management infrastructure, a key strength of the system is its modular nature, which will be able to interface with other existing and future advanced traffic management systems (ATMS). ◆



▼ Extent of Leicester City and A6 test site