# Optimisation Techniques
# for Transportation, Logistics, and Manufacturing

Evolutionary Computation and Machine Learning (ECML) group

## Journey planning for public transport networks

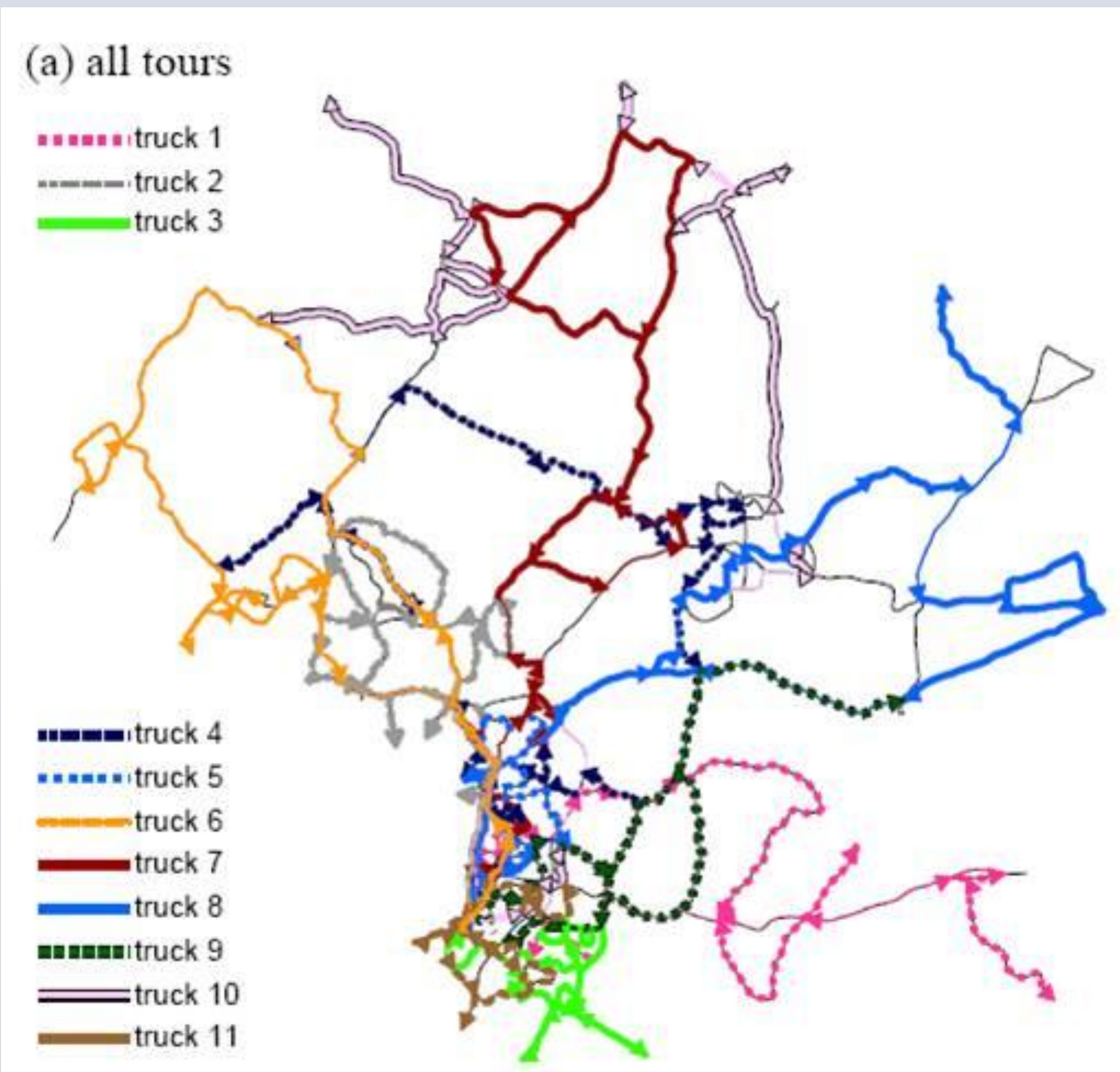
Public transport network plays an increasingly important role in a metropolitan city these days. As the use of public transport in cities increases, congestion and pollution decline and so do the associated costs and health problems. It is therefore important for such a network to be easily navigable so as to not discourage potential users.

We are building a journey planning tool using state-of-the-art techniques such as multi-objective optimization and evolutionary computing methods, taking into account users' preferences, e.g., fewer mode changes, faster travel time.

## Large scale capacitated arc routing problems

An important application of capacitated arc routing problems (CARP) is winter gritting in UK, where there are about 3,000 gritting routes, equivalent to 120,000km or 30% of the entire road network. Such a large project costs millions of dollars per year

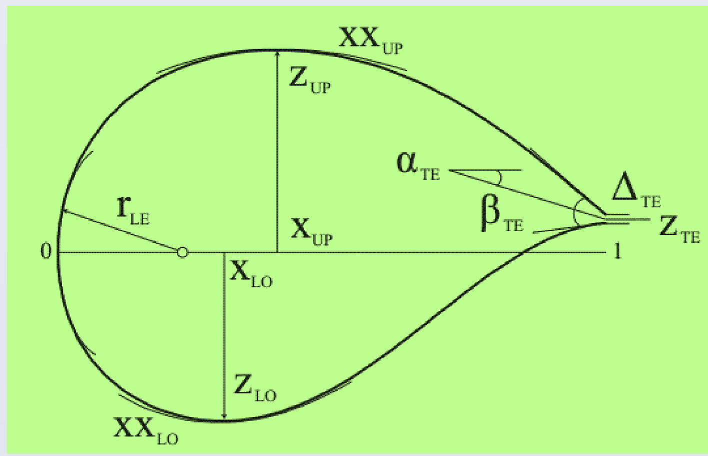
The Large Scale CARP (LSCARP) is practically significant, since the problem size (i.e., the number of streets) is very large in many real-world applications. For example, for the urban waste collection problem, there may be hundreds or even thousands of streets in the city for which waste is to be collected. Therefore, it is important to study how to solve LSCARP. Current CARP approaches to LSCARP have scalability issues. We employ a divide-and-conquer strategy to address the issue of large dimensionality.




## Designing airfoils using Swarm Intelligence techniques

In the aerospace industry, the process of aerodynamic shape optimization to low speed Unmanned Aerial Vehicles (UAV) is critical during all phases of design [1]. A recurring strategy in aerodynamic shape optimization is the integration of three distinct modules: 1) Geometry parameterization model; 2) Computational flow solver; 3) Efficient search engine. A discipline which has benefited greatly from optimization theory in the recent past is airfoil design. Airfoils denote the cross-section of any three-dimensional lifting surface, e.g., the main wing. Subsonic forces for wing airfoil sections arise from surface pressure or air viscosity.

We use a reference point based many-objective particle swarm optimization algorithm to optimize low-speed airfoil aerodynamic designs. Our framework combines a flexible airfoil parameterization scheme and a computational flow solver in the evaluation of particles. We used the baseline NLF0416 airfoil to obtain aspiration values, used to guide the swarm to preferred regions of the objective landscape to find solutions of interest.




## Warehouse storage optimization

Among warehouse operations, product storage and retrieval are considered as the most crucial and resource-consuming activities. One problem associated with these two activities is the Storage Location Assignment Problem (known as SLAP), which aims to determine the optimal storage arrangement of a warehouse so that the total operational cost is minimal. Products with higher demand rates should be stored at the storage locations that are easily accessible, and products with higher demand dependencies should be located near each other. To achieve this, optimization algorithms need to be able to predict future ordering status.

The problem is extremely challenging, as it is highly constrained with many conflicting objectives: many activities in the warehouse are inter-related, i.e., picking and batching policies used by pickers, and many activities change over time. An assignment may become sub-optimal due to the changing environments: fluctuating demand for products, availability of pickers, trolleys, etc, requiring the ability to track and adapt the changing optimum.

## Research contacts

For more information, contact Prof. Xiaodong Li, A/Prof. Vic Ciesielski, Dr Andy Song, Dr Jeffrey Chan about these projects or visit: https://titan.csit.rmit.edu.au/~e46507/ecml/

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