SpaceTimeLab

SpaceTimeLab's mission is to generate actionable insights from geo-located and time-stamped data for government, business and society. Using integrated space-time thinking, we develop theories, methods and platforms for prediction, profiling, visualisation and simulation.

SpaceTimeLab
for Big Data Anaytics

UCL ENGINEERING
Change the world

Our Portfolio

Our current project portfolio covers four key themes:

1. Transport and Mobility
2. Security and Policing
3. Business Intelligence
4. Environmental Resilience

We are also developing applications in the following areas with new partners:

5. Health
6. Economics

Transport and Mobility	Security and Policing	Business Intelligence	Environmental Resilience
Research Topics			
• Travel behaviour & pattern analysis • Traffic forecasting • Disruption simulation and estimation • Travel mode detection • Data fusion	• Crime prediction • Strategic planning • Intelligent patrolling • Performance evaluation • Public confidence modelling	• Profiling people and place • Targeted advertisement • Geodemographic indicators of small area • Abnormal behaviour	• Incident detection • Hazard mapping • Flooding prediction • Infrastructure risk modelling • Emergency response
Data Sources			
• Traffic data • Incident data • Smart card data • GPS trajectories • Cycle Hire Scheme • Fitness tracking • Travel demand survey	• Crime locations • Police patrol data • British Crime Survey • Public Attitude Survey	• Geolocated tweets • Census • Understanding society • Retail data • Output area classifications	• Meteorological data • Landscape susceptibility • Flooding • Forest fires
Funded Projects			
STANDARD Spatio-Temporal Analysis of Network Data and Route Dynamics **www.ucl.ac.uk/standard**	CrimePolicingCitizenship space-time interactions of dynamic networks **www.ucl.ac.uk/cpc**	Consumer Data Research Centre An ESRC Data Investment **www.cdrc.ac.uk**	INFRARISK **www.infrarisk-fp7.eu**

Funding and partners

TRANSPORT FOR LONDON EVERY JOURNEY MATTERS
ublox
EPSRC Engineering and Physical Sciences Research Council
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL
JRC EUROPEAN COMMISSION
Public Health England
METROPOLITAN POLICE
THE ROYAL SOCIETY
ARUP
STRAVA™

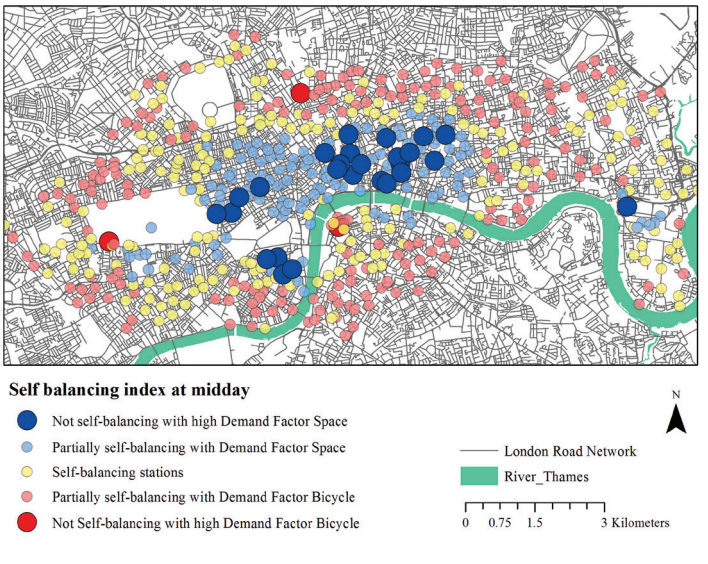
Transport and Mobility

The transportation system is the lifeblood of the city. At SpaceTimeLab, we work to ensure the health of the city by improving the mobility of its citizens and the function of its transportation system.

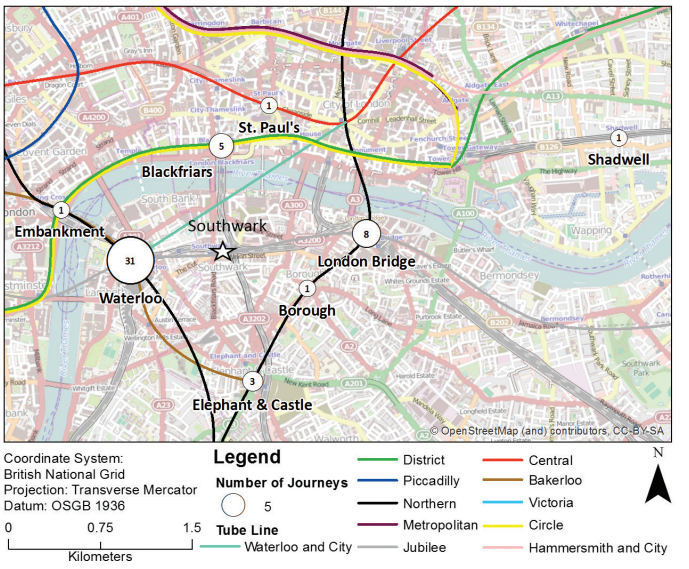
SpaceTimeLab is working on a number of projects using large, spatio-temporal transportation datasets to categorise, cluster and profile people and places.

Examples of our work include:

1. Prediction, simulation and visualisation of urban traffic flows.
2. Identifying flexible travellers and groups using smart card data.
3. Modelling the impact of engineering work and incidents on London tube lines.
4. Developing mobility solutions for cyclists using cycle hire and tracking app data
5. Detecting hybrid travel modes from sparse GPS data.



Examining the self balancing characteristics of bike-sharing docking stations



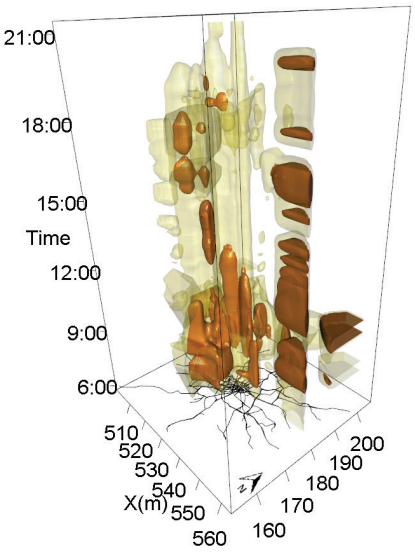
Identifying flexible travellers during planned disruptions on the London Underground

Spotlight:
The STANDARD Project (www.ucl.ac.uk/standard)

Working with TfL, the STANDARD (Spatio-Temporal Analysis of Network Data and Route Dynamics) project undertook methodology-led research to model the complexity of road networks, and to understand the nature and causes of traffic congestion. It pioneered integrated modelling of the spatio-temporal dependency in networks via combined statistical regression and machine learning.

The methodology focused on 5 key topics:

1. Short-term journey time prediction with missing data
2. Simulation of driver behaviour and network performance under disruptions
3. Early detection of non-recurrent congestion
4. 3D Visualisation & management of traffic data
5. Identification of macroscopic traffic parameters in Central London



3D Isosurface for congestion visualisation

Security and Policing

The safety and security of the public relies on police agencies maximising their use of the diverse geo-temporal data sources available to them.

Collaborating with the Metropolitan Police Service, the Crime, Policing and Citizenship (CPC) project (www.ucl.ac.uk/cpc) analyses and models the relationship between police activities, crime and public attitudes towards policing.

CPC focuses on:

1. Street network based crime prediction

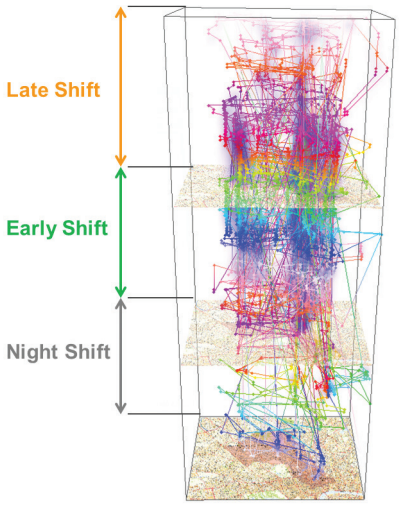
2. Police patrol behavioural analysis

3. Optimal patrol routing in real-time

4. Agent-based simulation for strategic planning

5. Spatio-temporal analysis of public confidence

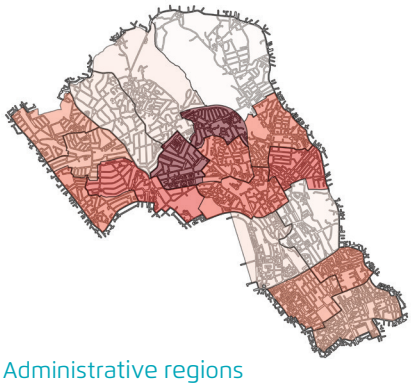
6. Supply and demand of police patrol coverage



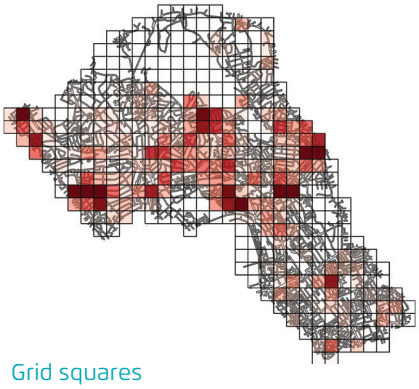
Identifying space-time points of interest of police officers from trajectory data

Spotlight:
Algorithms for intelligent policing

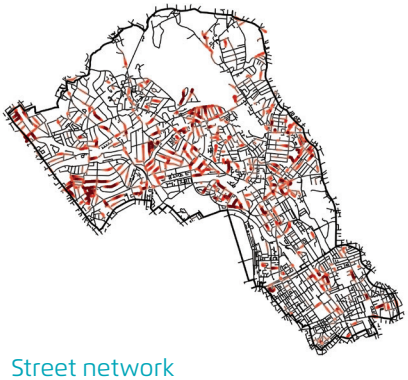
Cutting edge algorithms for daily crime prediction on different spatial units.



Administrative regions



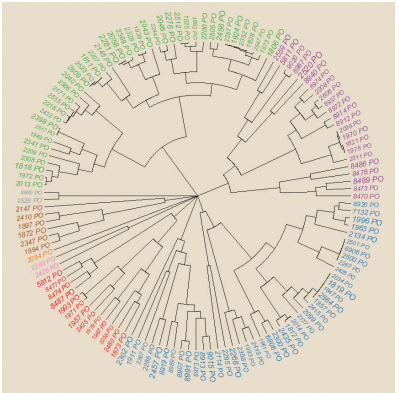
Grid squares



Street network

Optimal coordination of patrols in real-time

Comparing police movements and calls for service to identify under-patrolled streets



Grouping officers by patrol behaviour

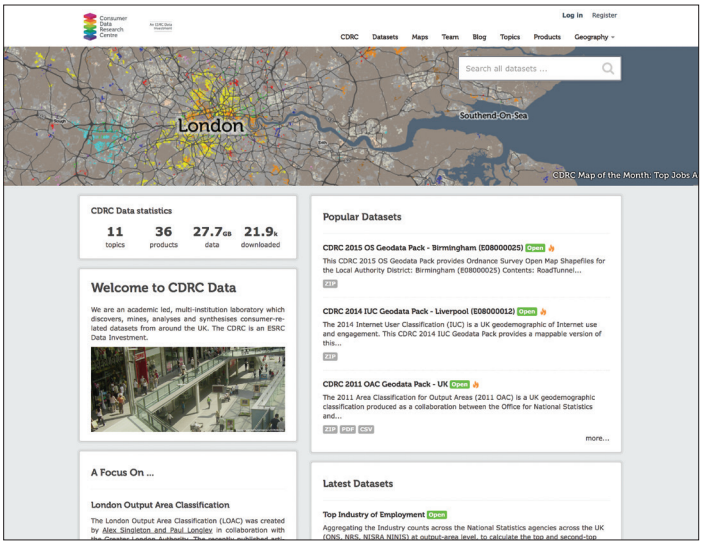
Business Intelligence

Many facets of business and commerce can be rationalised and improved through an understanding of the spatio-temporal patterns underlying consumer behaviour.

Examples include:

- Insurance fraud
- Footfall and catchment area estimation
- Consumer profiling
- Fleet and logistic management

The Consumer Data Research Centre, works with retail industries to open up their data to researchers in order to provide solutions that drive economic growth and societal improvement.

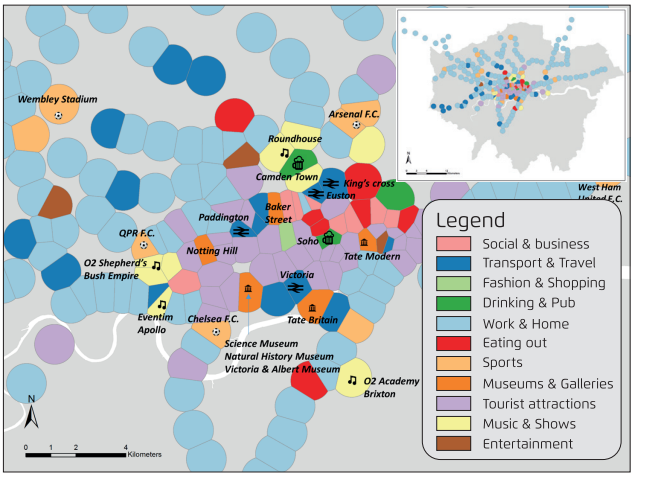


The CDRC data portal: data.cdrc.ac.uk

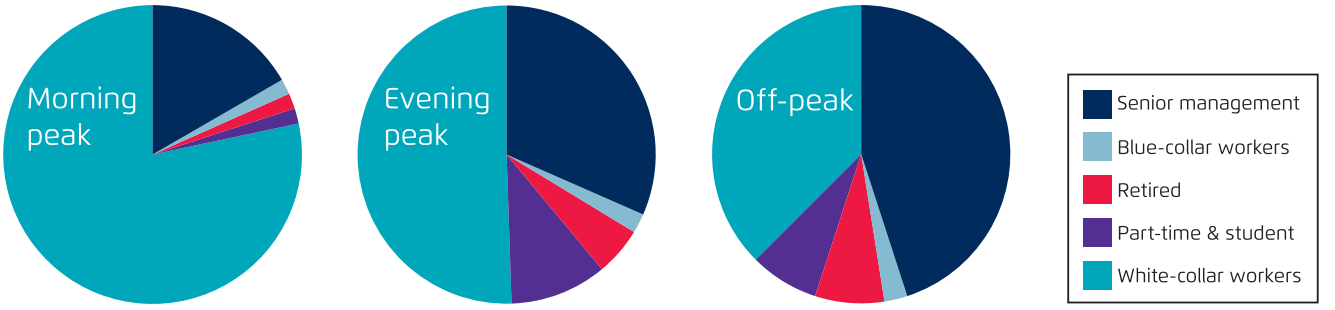
Spotlight:
Profiling people and places for targeted advertising

There are 24 million journeys made across London's transportation network per day. By profiling people and the places they visit, SpaceTimeLab gains insights into needs, allowing businesses to target their advertising in the right places.

We use geolocated Tweets to understand what people use different parts of the city for. Our research can help TfL to decide what advertising to place in their London Underground stations.



People's interest around London Underground stations extracted from geolocated Tweets



Classifying London tube users using Oyster card travel data

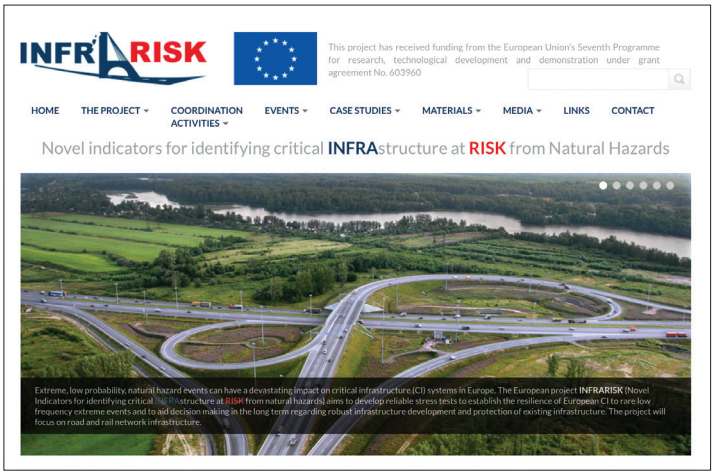
Environmental Resilience

Advancing knowledge and understanding of natural hazards and developing novel risk assessment methods is a core part of the SpaceTimeLab research agenda.

Recent work includes:

- Hazard susceptibility mapping
- Hazard risk assessment
- Flood forecasting
- Forest fire prediction

SpaceTimeLab is one of 11 partners in INFRARISK, a European Commission project that aims to test the resilience of critical infrastructure networks to a variety of natural hazards (www.infrarisk-fp7.eu).

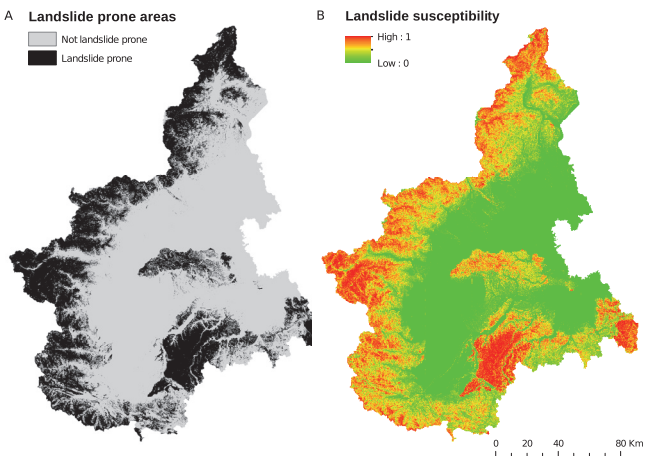


The INFRARISK website: www.infrarisk-fp7.eu

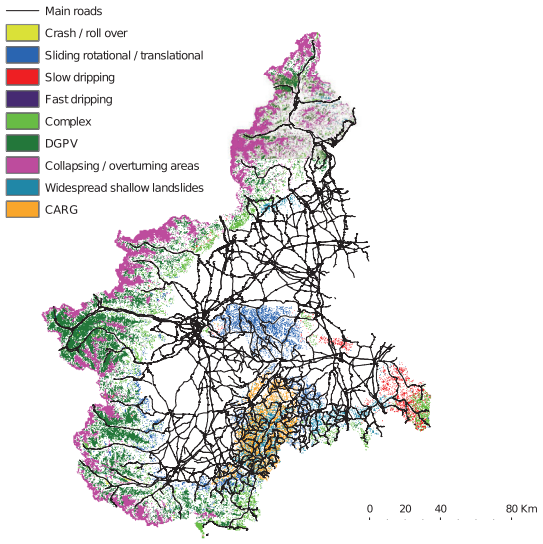
Spotlight:
Machine Learning Approach for landslide prediction

Random Forest, a decision tree based algorithm, is used to predict landslide susceptibility and type in the Piedmont region of Northern Italy. A combination of features is used, including soil classification, slope, rainfall, land use and topographic wetness.

Susceptibility and classification maps are combined to identify parts of the road network that are highly susceptible to the most damaging types of landslide.



Identifying and mapping areas susceptible to landslides



Landslide classification mapping in relation to the road network

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