Transport and Mobility

Spotlight on ERC projects

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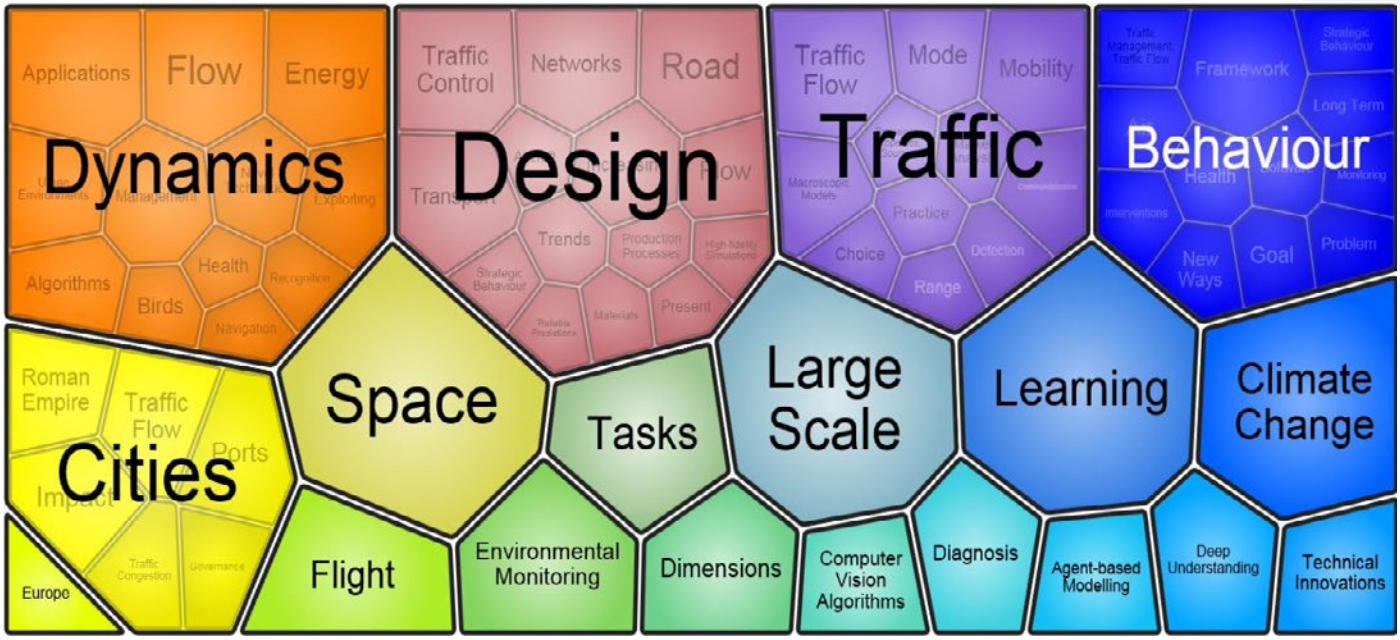
Clusters of most used keywords in ERC projects related to transport research



Introduction

Transport research encompasses a wide variety of topics in areas ranging from transportation science and technology, impact assessment of transport on environment and health, to the transport policy. The overall aim today is to improve transport infrastructure, vehicles and operations, while reducing its environmental footprint and integrating societal aspects, for example user behaviour, traffic planning and urban design.

The foundations of transport research lie in engineering, materials sciences, computer sciences and applied mathematics; but also in environmental sciences, sustainability sciences, public health, behavioural sciences and policy making. In this context, thousands of researchers around the world use a wide range of experimental approaches combined with modelling and simulations to develop more energy-efficient and environment-friendly transport systems. They focus on the development of new propulsion systems and engines, on designing and producing improved materials with enhanced properties, on building smart and interconnected transport and mobility systems, on the analysis of user datasets and the modelling of individual travellers' learning and adaptation, to name only a few examples.

This diversity of topics and approaches is reflected in the portfolio of transport research projects funded by the European Research Council (ERC) across the areas of physical sciences and engineering, life sciences and social sciences and humanities.

A sample of these projects is highlighted in this brochure as their lead researchers will be presenting their results at the 18th Transport Research Arena, (TRA), taking place from 16 to 19 April 2018 in Vienna (Austria).

Set up in 2007, the ERC is the first pan-European funding body designed to support investigator-driven frontier research and to stimulate scientific excellence across Europe. It aims to support the best and most creative scientists to identify and explore new directions in any field of research (Physical Sciences and Engineering, Life Sciences and Social Sciences and Humanities) with no thematic priorities and the only evaluation criterion being excellence. To date, the ERC has awarded over 8 000 long-term grants to individual researchers of any nationality and age who wish to carry out their research projects in Europe. With a budget of over €13 billion from 2014 to 2020, the ERC is part of the EU Research and Innovation framework programme, Horizon 2020.

Towards smarter traffic control

Severe traffic jams not only have an impact on mobility, they also raise environmental and health issues linked to fuel consumption and air and noise pollution. Prof. Ludovic Leclercq is developing new traffic control models that could tackle road congestion while integrating a green dimension.

How do individual behaviours influence the global performance of big traffic networks? Although traffic flow dynamics are well known at the local urban scale (few links and intersections), it is very difficult to apprehend congestion appearance and propagation directly at larger scales. Prof. Leclercq aims to bridge this gap by establishing a full set of interrelated multimodal traffic models able to capture drivers' behaviours at city level.

To do so, he combines real-mobility data collected in partnership with local authorities in Lyon, France, with data gained from dynamic simulations or serious game sessions involving students. His team has developed and is currently experimenting with a simulation game based on a microscopic traffic simulator: this will make it possible to build a huge dataset to study individual mode and route choices in a control environment.

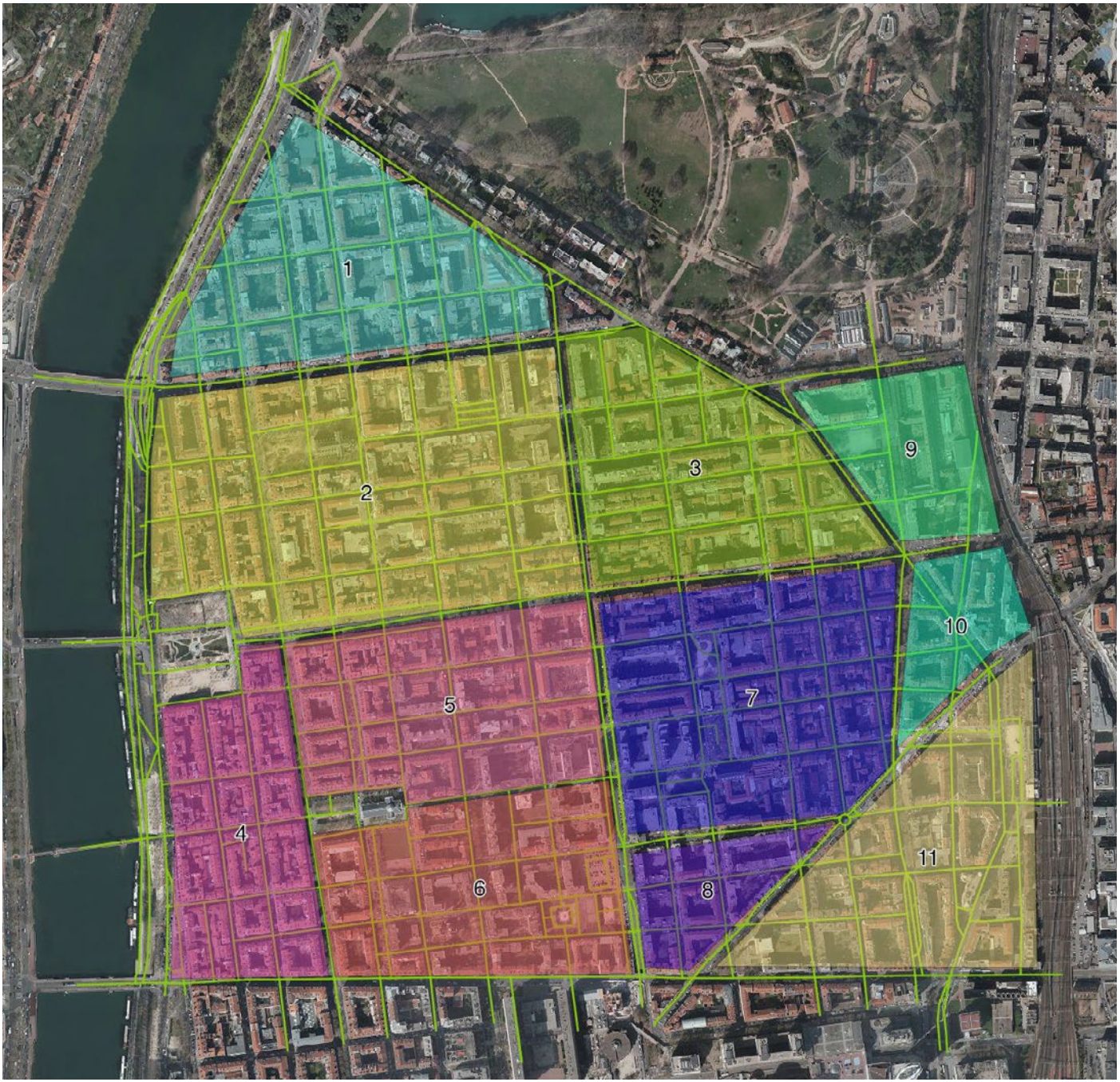
The models the team develops will be used to design and optimize traffic management strategies (TMS) with a tight focus on environmental concerns and multi-modality. Prof. Leclercq's research is very timely: the growing availability of real-time traffic data, greater connectivity and automation in vehicles make traffic control via advanced TMS more feasible than in the past. Innovative traffic control applications could have large benefits for road users, and local authorities, as well as urban transport planners.

Researcher: Ludovic Leclercq, French Institute of Science and Technology for transport, development and networks (IFSTTAR), France

ERC project: A Multiscale and Multimodal Modelling Approach for Green Urban Traffic Management (MAGnUM)

ERC funding: Consolidator Grant 2014, EUR 2 million (2015-2020)

Ludovic Leclercq is Research Director at IFSTTAR and Professor of Traffic flow theory at the University of Lyon (France). His research covers multiscale dynamic traffic modelling and the related environmental externalities. He is a member of the International Symposium on Transportation and Traffic Theory (ISTTT) advisory committee and of several editorial boards of Transportation journals. He has co-authored 56 papers in journals and received his PhD in 2002.



Decomposition of a city into “reservoirs” for large-scale simulation

Inspired by nature: bionic spider webs and other super-materials

Metal fatigue and ice-layer accumulation are challenges faced by the aviation industry and prove costly in terms of fuel waste. Sometimes nature can provide solutions to problems such as these. ERC grantee Nicola Pugno combines biological observations with nanotechnology to create some of the most remarkable materials in the world.

Natural materials such as spider silk, bones and nacre are remarkable for their exceptional mechanical properties, which make them interesting models for nanomaterials. Prof. Pugno explores the composition of natural structures, with the aim of tackling the drawbacks of currently used artificial products and develops new powerful solutions, tailor-made to specific industrial needs.

Spider silk and limpet teeth have been studied as some of the strongest materials known to man. Gecko feet are the basic inspiration behind a fabric with "spiderman-like" adhesion qualities. Lotus leaves could revolutionise the technologies behind waterproof objects, focusing on their nanostructure, rather than on currently used chemical treatments. Prof. Pugno's studies mimic nature, and enhance it, using the latest technological developments in the field of material sciences, in particular graphene and other nanomaterials.

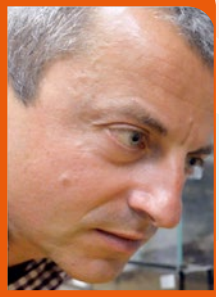
Further Proof of Concept grants awarded by the ERC have allowed him to elaborate manufacturing processes for these materials in order to produce them on a mass scale. Prof. Pugno's discoveries will have great impact on a variety of industrial fields, including the transport industry. His materials could allow for example the creation of airplane wings resistant to metal fatigue and less likely to accumulate layers of ice, leading to a dramatic reduction in fuel waste.

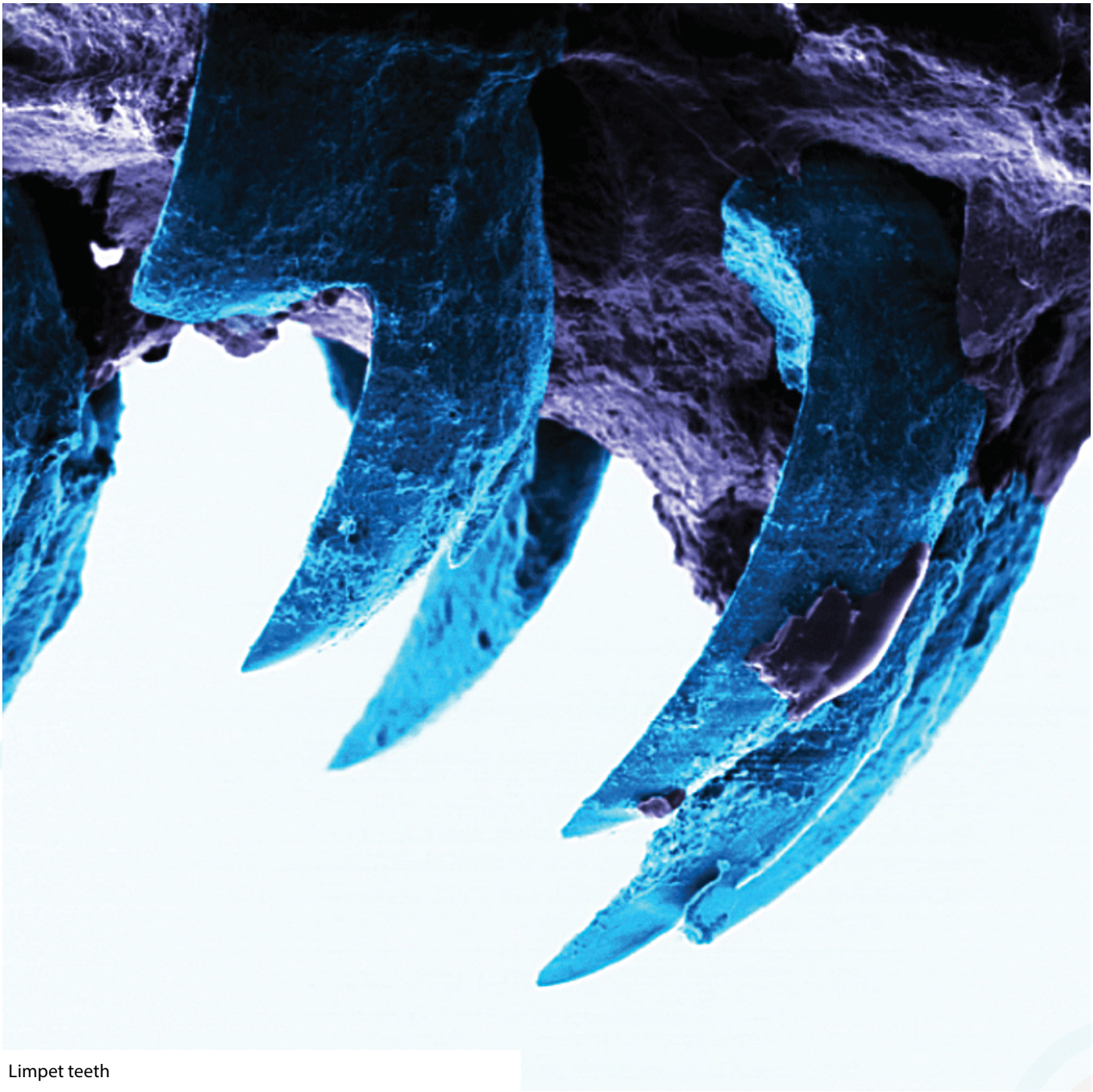
Researcher: Nicola Pugno, University of Trento, Italy

ERC project: Bio-inspired Hierarchical Super Nanomaterials (BIHSNAM)

ERC funding: Starting Grant 2011, EUR 1 million (2012-2016)

Born in 1972, Nicola Pugno holds PhD degrees in Engineering and Biology. He is Full Professor of Solids and Structural Mechanics at the University of Trento (Italy) since 2012 and of Materials Science at the Queen Mary University of London (UK) since 2013. He has published about 350 papers in international journals. In 2017 he was awarded the Griffith Medal and Prize.





Limpet teeth

Predicting the unpredictable: real time, reliable traffic apps

Travellers already benefit from applications harnessing data from sensor networks and smartphone users. They calculate alternative routes, help plan carpooling routes, or support the optimisation of public transport. With her ERC grant, Prof. Vana Kalogeraki works on a comprehensive software framework that will simplify the development of such mobile human-centred systems and make them more predictable and reliable.

We are increasingly connected through our mobile devices. Social media, data sensing, the widespread use of smartphones are changing the way we interact with each other and the world around us. Prof. Kalogeraki's team aims to take advantage of these new technologies to develop the next generation of large-scale mobile human-centred systems, robust enough to provide services that are timely and adapt to unpredictable changes.

The researchers investigate the use of mathematical models to address the impact of various factors, including disruption of the network, user mobility, different demands in case of unpredictable or emergency situations, changes in population growth and urban dynamics. They have developed a library of techniques that are now integrated into state-of-the-art systems and tested them with real-time detection of traffic issues in Dublin.

The team also designed the CrowdAlert app that enables users to receive traffic information in real-time from open sources such as streamed data coming from public buses, road sensors, social networks and private smartphones. Its truly human-centred design, taking privacy into consideration throughout the entire process, includes a constant feedback loop to evaluate the effectiveness of the app, its accuracy and performance. CrowdAlert could also support traffic management centres, allowing them to respond quicker in case of incidents. The app was promoted by the Dublin City Council in charge of traffic management.

Researcher: Vana Kalogeraki, Athens University of Economics and Business (AUEB) - Research Center, Greece

ERC project: Creating the Next-Generation Mobile Human-Centered Systems (NGHCS)

ERC funding: Starting Grant 2011, EUR 960,000 (2013-2019)

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Vana Kalogeraki leads the Distributed and Real-Time Systems research at AUEB. She has been working in the field of distributed and real-time systems, participatory sensing systems, crowdsourcing and mobility for over 20 years. Her research has been funded by the EU and the US National Science Foundation (NSF). She has been awarded an ERC Starting Grant, a Marie Curie Fellowship and various best paper and fellowship awards.

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How do pedestrians and cyclists move in traffic?

In urban areas, an increasing number of travellers are turning to more sustainable means of transport such as walking and cycling. The ALLEGRO project studies pedestrians and cyclists' behaviour in traffic, a field that offers many opportunities for ground-breaking knowledge.

In comparison with motorised vehicular modes of transport, walking and cycling have received little attention from researchers so far. Prof. Serge Hoogendoorn is focusing precisely on these so-called 'slow' modes of transport as the lack of understanding of their dynamics is becoming problematic in urban areas that experience more and more difficulties in dealing with large numbers of pedestrians, especially during events attracting large crowds.

The behaviours of pedestrians and cyclists, as well as their interactions with each other and with other modes of transportation, are much more complex and hard to predict than those of drivers, due to the high degree of freedom in their decision-making process. In fact, there are large behavioural differences between pedestrians and cyclists, on the one side, and motorists, on the other, as the former are less bound by traffic regulations.

Supported by the ERC, Prof. Hoogendoorn studies walking and cycling flows in order to establish a comprehensive theory of slow mode traffic and travel behaviour. His team uses innovative big data collection techniques, applied for example to the city of Amsterdam, including remote and crowd sensing, social media analytics, virtual and augmented reality. By combining data from these different sources, they are developing conceptual and mathematical models to explain and predict the dynamics of pedestrians and cyclists within an urban context. These models can be applied to a variety of circumstances and can facilitate new approaches in the management of crowds, the design of slow traffic infrastructure, and others areas. with the aim of improving safety, comfort and efficiency.

Researcher: Serge Hoogendoorn, Delft University of Technology, Netherlands

ERC project: unrAvelLing sLow modE travelinG and tRaffic: with innOvative data to a new transportation and traffic theory for pedestrians and bicycles (ALLEGRO)

ERC funding: Advanced Grant 2014, EUR 2.5 million (2015-2020)

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Professor Serge Hoogendoorn is the chair of the Transport & Planning department and he is currently one of the four Distinguished Professors of Smart Urban Mobility at Delft University of Technology (DUT), Netherlands. He is one of the leading international scholars in the transportation field. His current research evolves around Smart Urban Mobility.

Going mainstream:
why and how disruptive innovations in mobility are adopted

Peer pressure plays an important role in spreading new trends and habits. But what impact does social influence have in the diffusion of disruptive innovations that challenge prevailing transport technologies and mobility practices? Funded by the ERC, a team led by Dr Charlie Wilson is looking into this matter.

Innovations are defined as disruptive when they create a new market, a new set of demands and preferences. Car clubs, mobility-as-a-service, ride-sharing, shared autonomous vehicles, electric vehicle-to-grid, and electric bikes are all examples of potentially disruptive innovations on the fringes of mainstream markets, but which could help transition towards a lower-carbon society. In the absence of strong policy incentives, social communication from users to non-users is an important means by which these innovations spread. In order to strongly reduce carbon dioxide (CO_2) emissions and, eventually, contribute to mitigating climate change, these innovations must diffuse from small market niches into mainstream markets.

Dr Wilson is interested in how and why disruptive low-carbon innovations are adopted and how they spread. Information exchanged on social networks, interpersonal communication or interactions in local neighbourhoods influence people's behaviour. Does this apply to disruptive innovations with significant emission reduction potentials? Can these diffusion processes be harnessed to accelerate change?

Using rigorous scientific methods applied to a wide range of data collected in multiple countries, Dr Wilson addresses this critical knowledge gap, opening up a new scientific field on disruptive low-carbon innovation. Results could have strong implications for energy, environment, and climate change policy, supporting the development of models, strategies and actions to accelerate low-carbon transitions. The SILCI project could give new insights to meet the climate mitigation targets agreed by the EU.

Researcher: Charlie Wilson, University of East Anglia, United Kingdom

ERC project: Social Influence and disruptive Low Carbon Innovations (SILCI)

ERC funding: Starting Grant 2015, EUR 1.2 million (2016-2020)

Dr Charlie Wilson is a Reader in Energy and Climate Change at the University of East Anglia, and a co-leader of the Accelerating Social Transitions research theme of the Tyndall Centre for Climate Change Research in the UK. He is also a visiting research scholar at the International Institute for Applied Systems Analysis (IIASA) in Austria. His research interests include energy innovation and its role in long-term decarbonisation.

Addressing the complexity of road traffic networks

Everyone who has ever been stuck in traffic knows how frustrating and time-wasting it can be. ERC grantee Carlos Canudas de Wit is working on a global approach to improve traffic management systems using the new technologies and innovations that have not yet been fully exploited.

Control system theory tried to address some of the problems involved in managing road networks, but controlling these large networks remains still problematic and traffic management systems do not always prevent the occurrence of congestion. In order to address network complexity in the widest sense, Dr Canudas de Wit proposes to design novel mathematical scale-free methods which can be used to break down complexity in large-scale network systems, and then to build estimation and control algorithms that could be specifically tailored to these models.

He and his team will test the new theoretical developments with high-performance field experiments and realistic simulations at Grenoble Traffic Lab, an experimental platform collecting various kinds of real-time urban traffic data from the city of Grenoble. In addition, the methods based on real-time data collected from different sources will enable the team to create a unique traffic database, which will be made available for further studies.

Thanks to a comprehensive approach and using the new opportunities presented by the latest large-scale sensing technologies, the Scale-FreeBack team expects to come up with some innovative traffic control solutions. Their hope is to improve control and security of large traffic networks, but also to find new solutions that can be applied to other complex systems, such as power distribution networks, and multi-agent systems, among others.

Researcher: Carlos Canudas de Wit, French National Center for Scientific Research (CNRS), France

ERC project: Scale-Free Control for Complex Physical Network Systems (Scale-FreeBack)

ERC funding: Advanced Grant 2015, EUR 2.5 million (2016-2021)

Born in Mexico, Carlos Canudas-de-Wit holds a Ph.D. in automatic control from the Polytechnic of Grenoble (France). He is Director of Research at the French National Center for Scientific Research (CNRS), where he teaches and conducts research in the area of control systems. He is the currently the leader of the Networked Controlled Systems team. He is an IEEE and IFAC IEEE-Fellow.

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"The European Research Council has, in a short time, achieved world-class status as a funding body for excellent curiosity-driven frontier research. With its special emphasis on allowing top young talent to thrive, the ERC Scientific Council is committed to keeping to this course. The ERC will continue to help make Europe a power house for science and a place where innovation is fuelled by a new generation."

Jean-Pierre Bourguignon
ERC President and Chair of its Scientific Council

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