

# Loughborough University – Areas of Expertise in Rail

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Loughborough is research intensive University made up of 9 schools at the East-Midlands campus and a further one at the London campus. It is highly active in the rail sphere, with this activity focused in three main schools

- Wolfson School of Mechanical, Electrical and Manufacturing Engineering (MEME)
  - <https://www.lboro.ac.uk/departments/meme/>
- School of Architecture, Buildings and Civil Engineering (ABCE)
  - <https://www.lboro.ac.uk/departments/abce/>
- School of Design and Creative Arts (DCA)
  - <https://www.lboro.ac.uk/schools/design-creative-arts/>

Each of these Schools contains a diversity of activities and researchers.

## MEME

The Control Systems Group is a founding member of UKRRIN in both the Rolling Stock and Infrastructure Centres. This led to the framework agreement that is currently in place with Network Rail. The following are core research areas and people involved in rail projects in the Control Systems Group and the school. Example projects can be found in the appendix.

## Research Areas

- Mechatronic system design (vehicle and infrastructure)
- Advanced control and condition monitoring methodologies (vehicle and infrastructure)
- Hardware-in-the-loop testing
- Vehicle drivetrain modelling (including emissions and consumption)
- Vehicle and track interaction dynamics and simulations (first principles and multi-body dynamics)
- Systems engineering
- Electromagnetic compatibility (EMC) and mobile/radio communications modelling and testing

## People

Name	Title	Expertise
Dr Christopher Ward	Senior Lecturer in Control Systems Engineering	Control, condition monitoring, rail vehicle dynamics, fault tolerant design
Dr Will Midgley	Senior Lecturer in Intelligent Mechatronics and Control Systems Engineering	Vehicle emissions and energy usage modelling, control to reduce vehicle emissions and energy usage, battery vehicle modelling

Dr Peter Hubbard	Lecturer in control system engineering	Control, interfacing, systems engineering, dynamics
Dr Tim Harrison	Senior research associate	Dynamic modelling, fault tolerant systems, electro-mechanical design, testing
Dr James Flint	Reader in Wireless Systems Engineering	EMC, communications, RF interference
Prof. Michael Henshaw	Professor of Systems Engineering	Through-life management of systems and interoperability
Dr Ella-Mae Hubbard	Senior lecturer in Systems Engineering	Systems and organisational ergonomics and human factors, technology acceptance and trust, productivity

## ABCE

### Research Areas

- Early fault diagnosis, vibration monitoring and optimal maintenance strategies for structures
- AI and machine learning methods for drainage condition monitoring, modelling and management
- Asset management for drainage systems
- Corrosion protection of reinforced concrete structures
- Earthworks – grid reinforced structures, modelling, lifecycle
- Carbon evaluation calculators for infrastructure maintenance and management
- Track bed and track system performance modelling
- Geotechnics
- Tunnels – safety and hazard evaluation, sustainability

### People

Name	Title	Expertise
Sergio Cavalaro	Professor of Infrastructure Systems	Building and structural engineering, tunnel design and construction, manufacturing processes for construction.
Matthew Frost	Senior Lecturer, Geotechnical Engineering	Maintenance strategies for drainage systems, geogrid performance modelling and analysis, track bed and track system performance modelling
Alessandro Palmeri	Reader in Structural Engineering and Dynamics	Design, optimisation and control of structures exposed to dynamic actions
Ana Blanco	Lecturer in Infrastructure Engineering	Concrete technology in infrastructure
Craig Hancock	Senior lecturer in Surveying	Use of GPS and GNSS in monitoring structures and mapping utilities
Mingzhu Wang	Lecturer in Construction Management	Application of IoT to construction management

Chris Goodier	Reader in Construction Engineering and Materials	Modular construction methods. Hybrid corrosion protection of reinforced concrete
Alister Smith	Senior Lecturer in Civil Engineering	Acoustic emission monitoring for geotechnical applications
Ashraf El-Hamalawi	Reader in Engineering Modelling	Carbon lifecycle tool for transport infrastructure, track bed and track system performance modelling
Tom Dijkstra	Senior lecturer in Engineering Geology	Geohazards and effects of climate change on transport earthworks and infrastructure



## Research Areas

- Track worker safety
- Human factors associated with fatalities and near misses

## People

Name	Title	Expertise
Patrick Waterson	Professor of Human Factors and Complex Systems	Trackworker safety, non-technical skills, trespass, crowding and crowd management, safety at train stations, customer experience, human factors and rail
Tracy Ross	Senior Lecturer in People-Centred Design	User-engagement methods for developing new transport innovations, crowdsourcing user experiences as an input to design, inclusive design

## Appendix

### MEME example projects

Project/area title	Description	Challenge statement alignment	Links
Low adhesion estimation	A series of projects have looked at using in service vehicle and inertial sensing to determine the level of adhesion in real time.	Operations	<a href="https://www.lboro.ac.uk/internal/news/2022/january/new-train-system-will-detect-leaves-on-the-line/">https://www.lboro.ac.uk/internal/news/2022/january/new-train-system-will-detect-leaves-on-the-line/</a>
Actiwheel	Active guidance of an independently rotating wheelset vehicle	Operations	<a href="https://www.lboro.ac.uk/departments/meme/research/">https://www.lboro.ac.uk/departments/meme/research/</a>

			<a href="#">research-projects/actiwheel/</a>
REPOINT	Fault tolerance for track switches	Operations	<a href="https://www.lboro.ac.uk/enterprise/repoint/">https://www.lboro.ac.uk/enterprise/repoint/</a>
Energy and emissions reduction through control	A series of projects that looked at control and intermittent electrification with battery infill to reduce energy usage and emissions of rail vehicles	Electrical Power; Environment and Social	<a href="https://dte.network/first-call-results">https://dte.network/first-call-results</a> <a href="https://www.rssb.co.uk/research-catalogue/CatalogueItem/COF-IPS-02">https://www.rssb.co.uk/research-catalogue/CatalogueItem/COF-IPS-02</a>
Systems Engineering	Systems approach to an evolved nuclear sector deal and net-zero	Environment and social, Operations	<a href="#">Systems Approach to an Evolved Nuclear Sector Deal and Net-Zero - Nuclear Industry Association (niauk.org)</a>

### ABCE example projects

Project/area title	Description	Challenge statement alignment	Links
Earthworks	Modelling of the deformation of geogrids used in earthworks	Building and civils	<a href="#">Modelling deformation during the construction of wrapped geogrid reinforced structures</a>
Energy and decarbonisation	Carbon footprint and reduction analysis tool	Building and civils	<a href="#">Development and Implementation of a Carbon tool for Highway maintenance</a>
Tunnelling	Fibre reinforced concrete in tunnel linings	Building and civils	<a href="#">Safety format for the flexural design of tunnel fibre reinforced concrete precast segmental linings</a>
Climate change	Effect of climate change on transport infrastructure	Environment and Social	<a href="#">FUTURENET: Future Resilient Transport Networks, part of the ARCC Adaption and Resilience to a Changing Climate programme</a>

### DCA example projects

Project/area title	Description	Challenge statement alignment	Links
DICE	Data to Improve the Customer Experience	Operations	<a href="http://www.dice-project.org.uk/">http://www.dice-project.org.uk/</a>
TOC Ability	Intelligent Accessibility Hub	Operations	<a href="https://www.rssb.co.uk/research-catalogue/CatalogueItem/SC12-TCX-09">https://www.rssb.co.uk/research-catalogue/CatalogueItem/SC12-TCX-09</a>
Passenger boarding	Using real-time data on train consist and loading to influence passenger positioning and boarding behaviour	Operations	<a href="https://www.rssb.co.uk/research-catalogue/CatalogueItem/COF-PTI-05">https://www.rssb.co.uk/research-catalogue/CatalogueItem/COF-PTI-05</a>
Passengers with special needs	Integrating data sources to enhance the experience for passengers with special needs through privacy aware mobile applications	Operations	<a href="https://www.rssb.co.uk/research-catalogue/CatalogueItem/COF-ICE-04">https://www.rssb.co.uk/research-catalogue/CatalogueItem/COF-ICE-04</a>