



# TRANSPORT

The University of Birmingham is developing innovative solutions to improve safety, performance and environmental issues for rail and road transport. Its pioneering research in this area includes rail, automotive engines, automotive radar and hydrogen fuel cells.

## RAIL

### Background

Society relies on railways more than ever before: they have become integral to how people live and how economies grow in the 21st century. Our researchers use close links with the rail industry to understand and research solutions to enable the world's railways to improve operations, reliability, efficiency and the experience of their customers.

BCRRE takes a systems wide view of railways, researching all aspects of railway technology and operation. It has built a world class reputation in the following areas:

- **High Speed railways:** Optimising the aerodynamics of high speed trains and their interaction with the infrastructure (for instance, optimising the interactions as trains enter and pass through tunnels)
- **Traffic Management and Operations Simulation:** Developing simulators and algorithms for use in train control systems that maximise the capacity of train networks and allow railways to recover quickly from disruption.
- **Power and Energy:** Optimising design and operation of railway systems to reduce maximum power requirements and the use of energy. – Energy savings of well over 10% have been realised for metro systems BCRRE has worked with and the potential to save much more has been identified.
- **Railway Data Integration:** Designing

data models and architectures to integrate railway data effectively, allowing trains to run on time while offering a more integrated and personalised experience to customers.

#### ■ Climate Change and Extreme Weather

**Impact:** Identifying the trends of climate change and their likely impact to develop solutions for how railway infrastructure and operational practices can be adapted to ensure secure and reliable operation as extreme weather conditions become more frequent.

### Key projects

We take a system-wide view of railways, researching in all aspects of railway technology and operation and has built a world-class reputation in the following areas:

- High speed railways
- Traffic management and operations simulation
- Power and energy
- Railway data integration
- Climate change resilience and extreme weather response
- Smart conditioning monitoring
- Railway aerodynamics

## AUTOMOTIVE ENGINES

### Background

Our Future Engines and Fuels Laboratory houses ten engine test bed facilities for engines, fuels and catalysts. We carry out extensive collaborative work with businesses, including Jaguar Land Rover, Ford, Johnson Matthey and Shell.

## AUTOMOTIVE RADAR

### Background

University of Birmingham communications engineers have been involved in the Research and Development of 'adaptive cruise control' (ACC) radar and 'blind spot monitoring' (BSM). ACC enables a vehicle to automatically adjust

its speed, by controlling the throttle and brakes, to maintain a safe distance from a target vehicle ahead and other objects nearby. ACC and BSM are now integral to the Jaguar Land Rover (JLR) range (since 2008, JLR has sold more than 47,000 vehicles equipped with ACC and more than 126,000 with BSM) and other car manufacturers are also incorporating it into their vehicle design.

University of Birmingham engineers have also worked on pedestrian and collision-avoidance systems, such as investigating the effects of rain and spray and radar interpretation of vehicles, pedestrians, animals, bicycles and road infrastructure.

## HYDROGEN AND FUEL CELLS

### Background

The Centre for Hydrogen and Fuel Cell Research (CHFCR) doesn't focus solely on cars, however. We are developing fuel cell systems for other modes of transport, including:

- **Trains:** The first prototype hydrogen-powered locomotive of its kind to operate in the UK was built by engineering students and staff. The narrow gauge loco combines a hydrogen fuel cell and lead acid batteries similar to the ones used in cars.
- **Planes:** We have been working with the EADS Group, a global leader in aerospace, defence and related services, to develop fuel cells for unmanned aerial vehicles.
- **Boats:** A hydrogen-powered canal boat has been built on campus, powered by a combination of a metal hydride solid-state hydrogen store, a proton exchange membrane (PEM) fuel cell, a lead acid battery stack and an NdFeB permanent magnet electric motor.

## RAIL

### The evidence

The Birmingham Centre for Railway Research and Education (BCRRE) at the University of Birmingham are leaders in railway science and education. With over 125 academics, researchers and professional support staff, BCRRE delivers world class research and thought leadership within railways as well as providing an expanding portfolio of high-quality education programmes.

The International activity of BCRRE brings together extensive partnerships with leading academic institutions and industrial organisations, leveraging its knowledge, skills and research outputs in key locations around the globe. BCRRE has existing research collaborations in many countries including China, Japan, USA, Singapore, Sweden, France and Germany.

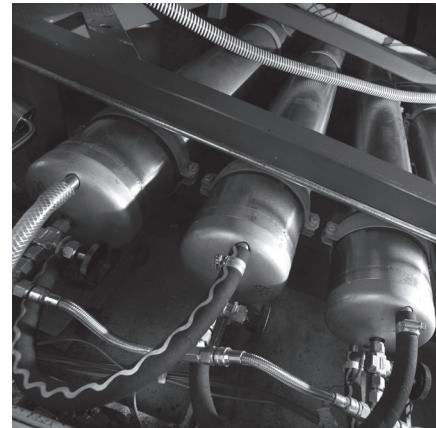
BCRRE has strong collaborative links with RailTEC based at the University of Illinois at Urbana-Champaign; North America's largest university based railway research centre. BCRRE and RailTEC have jointly bid for several US government and industry funded asset management and traffic management projects.

In China, BCRRE has research collaborations with Beijing Jiaotong University, Beijing Municipal Government, Beijing Metro, Guangzhou Metro and has set up a joint University of Birmingham Anhui Province railway research centre in Hefei city.

## AUTOMOTIVE ENGINES

### The evidence

- Johnson Matthey has been able to optimise its environmental catalyst technology helping to reduce regulated and unregulated pollutant emissions and lessening the environmental impact.
- Shell has been able to design biofuels, derived from Brazilian sugar cane, that are compatible with current engine technologies.
- Jaguar Land Rover (JLR) has been able to improve current and future generation engine technology, including the next generation of gasoline direct injection (GDI) combustion technology. Using our research, JLR has been able to improve the flexibility of its engine technology to accept a wide range of environmentally friendly fuels.



## HYDROGEN AND FUEL CELLS

### The evidence

- The University of Birmingham manufactures its own fuel cells which are then tested and optimised in our laboratories.
- The University of Birmingham has a five-strong fleet of hydrogen cars which have gone through a series of improvements. The next generation will soon be undergoing trials on Birmingham roads.
- The University of Birmingham was home to the UK's first public hydrogen filling station – there are now other filling stations in the network the development of which is crucial for the commercial success of fuel cell cars.
- The University of Birmingham is collaborating with the University of Illinois at Urbana-Champaign around the development of new catalysts for fuel cell applications.

## AUTOMOTIVE RADAR

### The evidence

University of Birmingham research led to the EU Technical Committee setting the European radio frequency spectrum standard on automotive radar. We provided radar expertise to the committee, which included representatives from BMW, Daimler-Benz, Fiat, Volvo, M/A Com, Siemens and GEC Plessey.



## THE UNIVERSITY OF BIRMINGHAM HAS A FIVE-STRONG FLEET OF HYDROGEN CARS

WHICH HAVE GONE THROUGH A SERIES OF IMPROVEMENTS. THE NEXT GENERATION WILL SOON BE UNDERGOING TRIALS ON BIRMINGHAM ROADS.

