PhD Studentships – In Vehicle Aerodynamics. Contact: Prof Martin Passmore

We are recruiting five PhD students to add to our current group working in Vehicle Aerodynamics. The projects are all in collaboration with Jaguar Land Rover and are funded by Loughborough University, Jaguar Land Rover and the EPSRC.

Loughborough University has the largest and most active vehicle aerodynamics research group in the UK and is recognised as an internationally leading group in the field. The five projects on offer are focused on reduction of aerodynamic drag, building on existing research in this area and in surface contamination, complementing research funded by the EPSRC and JLR in the Programme for Simulation Innovation (PSi).

The reduction of aerodynamic drag is recognised in the automotive council roadmap as a major component in the reduction of carbon emissions from road vehicles and is critical in the development of range limited electric vehicles. Changes to emissions and CO_2 reporting legislation (World Light-vehicle Test Protocol, WLTP) will increase the importance of vehicle aerodynamics considerably for vehicle manufacturers making it imperative that better understanding of existing drag reduction methods is developed and that new methods and technologies are developed.

While many of the easier routes to lower aerodynamic drag have already been exploited there are opportunities for further gains in a number of areas if our understanding of the key physics is improved. The research in these projects is designed to make major advances in this understanding.

1. Wheel system aerodynamics.
The wheels and their interaction with the wheel arch, side body and underbody are significant contributors to the overall vehicle drag. This PhD programme will investigate this contribution, including; wheel windage losses, the effects of deformable tyres and wheel and wheel arch geometry. The project will be primarily computational but there will be opportunities to undertake experimental work to produce validation data.

2. Front end flow control.
The front corner of a car, in plan view, has a significant influence on the overall drag because it controls the acceleration of the air onto the body side and into the region ahead of the front wheels. Consequently it influences front wheel drag, the performance of aerodynamic features on the lower body side, the interaction with the wheel arch and also the rear wheel drag. This PhD programme will explore the potential for novel flow control technologies (passive, semi active and active) to provide drag reductions while also giving freedom in the styling of the car. Physical (reduced-scale wind tunnel) and numerical simulations will be used to understand the structure of the flow, identify opportunities for flow control, propose new approaches and determine their likely performance.

3. Computational studies of base pressure for generic SUV geometries.
This project will investigate the effects on base pressure and drag of simple geometric changes to the rear end and underbody, to include an analysis of the correlation between wake structure and base pressure. This programme will complement existing experimental work by investigating the use of ducting, flying D pillars, integrated spoilers, interaction between upper body and lower diffuser, vortex generators and surface texture to increase base pressure. This project will be primarily computational.

4. Base drag reduction. (EPSRC Industrial Case award)
This project will explore the potential for base drag reduction technologies for cars and SUV's. The programme is primarily experimental using flow-field measurements to understand the structure of the flow and identify opportunities for flow control. This may include the use of active and passive jets, exploiting rear wheel wake interaction or

manipulating base surface roughness. Measuring and understanding the role of flow unsteadiness in base drag generation is central to this work.

5. *Surface Contamination. (EPSRC Industrial Case award)*

This project will develop and test the capability to simulate surface water dynamics relevant to vehicle operation in adverse weather. The work will focus on generic geometries representing, for example, a car wind screen, a-pillar and side glass with a focus on cases that capture the core physics. Numerical simulation will explore the use of a new Coupled Level Set / Volume of Fluid approach allied to high-resolution aerodynamic models. Modelling of droplet contact properties will be explored – semi-empirical models of contact angle, effects of surface type, liquid properties (clean, variable solids fraction) along with contact models – splash, stick etc. In addition, there may be opportunities to explore the use of super-hydrophobic, super-hydrophilic and smart materials to control surface water deposition and movement without recourse to visually intrusive steps and channels. The project is primarily computational but may also involve some experimental work.

- Successful candidates will be expected to work closely with the Industrial partner and to make presentations at review meetings and workshops. They will also be encouraged to undertake short placements with the industrial partner and to travel to International conferences and seminars.

- Applications are open to EU and UK nationals. Candidates must be expecting, or have already obtained, a first degree (1st class, 2:1 honours or equivalent) in engineering, physics or mathematical sciences. Good communication skills are essential.

- The preferred starting dates for the projects is October 2015 although we will consider later starts for exceptional candidates. The package includes all funding for tuition fees plus a bursary of **£16,000** per annum tax free for 3.5 years (4 years for the Industrial case awards.) The projects all also have generous funding for computers, lab equipment and travel, including attendance at international conferences.
- Applications can be directed through the university website at http://www.lboro.ac.uk/study/postgraduate/howtoapply/ **Applications will be considered as they are received** and studentships allocated so you are encouraged to apply as soon as possible. For an informal chat about the opportunities and for further information you are welcome to contact Prof Martin A Passmore m.a.passmore@lboro.ac.uk Tel +44 (0)1509 227250
- Closing date 29th May.
- Details of the Department of Aeronautical and Automotive Engineering can be found at: http://www.lboro.ac.uk/departments/aae/