The role of driving simulators in electric vehicle research and development

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• History of Simulation lab
• EV research at AMAP
• How Driving Simulation can contribute to low carbon motoring
• Future aspirations
Who we are

• AMAP is part of the Faculty of Applied Sciences within the University of Sunderland

• AMAP is active in a number of projects in:
  – Ultra Low Carbon Vehicles
  – Digital Manufacturing
  – Reliability and Condition Monitoring
  – Industrial Maintenance and Efficiency
Simulator lab

• The AMAP Driving Simulator Lab was established in 1999.
• Projects have focussed on a variety of areas ranging from Human Factors to Vehicle Design
• We currently have two driving simulators:
  – Developed In-House
  – Forum 8
Developed In-House Simulator

• Three projection screens for maximum immersion
• Cockpit hardware developed by AMAP
Applications

• Previous work on the simulator includes:
  – AGILE (Aged people Integration, mobility, safety and quality of Life Enhancement through driving)
  – Age-related visual search during right turn gap acceptance maneuvers
  – Ability to perform a simulated emergency stop wearing a leg cast or brace
  – Cognition in pregnancy: perception and performance
Applications

• Used alongside equipment such as eye-tracker, EEG
• Used to assess driver behaviour in a variety of scenarios
Forum8 Simulator

• Acquired in 2010
• The display consists of three 32 inch LCD screens
• New configuration:
Ultra Low Carbon Vehicle Research

• Begun in 2006
• Focus areas
  – Human factors
    • Efficient driving techniques
  – Drive trains and gearboxes
  – Electrical energy conversion
    • Power flow control PhD
Examples of EV projects
Driving Simulation and ULCV Research

• 3 Critical Issues for EV development
  – **Driveability** – optimisation research should be based upon realistic driving conditions rather than standard patterns.
  – **Braking behaviour** – regenerative braking means energy can be recovered but such systems should not compromise safety.
  – **Practical design** – research currently done leaves many implementation issues; e.g. some methods for control are just too computationally intensive.
Driving Simulator Applications: Dynamometer Interconnection

- A test platform for EV drive train components was developed in 2011
- Motors, batteries, controllers etc can be tested under realistic conditions
Driving Simulator Applications: Dynamometer Interconnection

- We are now working towards interconnection between the driving simulator and the dynamometer.
Driving Simulator Applications: Dynamometer Interconnection

• The vehicle’s physical properties can be modified to suit the application
Driving Simulator Applications: Vehicle models

- The Forum8 UCWinRoad software provides a detailed Internal Combustion Engine Model

- Using the Software Development Kit we plan to develop models of hybrid and fully electric vehicles

- This will allow us to evaluate the driveability and efficiency of these vehicles with real drivers
Driving Simulator Applications: Vehicle Models

• Integration of simulator with MATLAB/Simulink models for human in the loop evaluation
Eco driver training: DROPLET

- The Forum 8 driving simulator was recently used in the delivery and evaluation of a new Eco driving course for safe driving.
- The course, named the DROPLET Course (Driver Optimisation for Low Emissions Transport) is based on theoretical models of driver training and provides a comprehensive framework for goals and content of driver education.
- A driving simulator, classroom-based and on-road driving techniques were used to modify driver behaviour.
Eco driver training: DROPLET

- Eco-drive Plugin provides information on fuel economy of journey
- A substantially larger improvement was evident in participants who took the on-road training course
Supporting developments: creation of bespoke routes

• In order to evaluate vehicles and hardware we have a local test route which comprises three distinct driving styles.

• We are currently working towards creating this route in the simulator.
Supporting Developments: Creation of Bespoke Routes

• In order to create bespoke routes several enabling technologies have been developed
Future development plans

• Ongoing development of dynamometer interconnection
  – Addition of second motor to hardware test platform
• Development of more local routes
• Development of driver training courses for more efficient driving
• Use of custom routes to evaluate vehicles in the situations where they will operate
• Use of vehicle models to evaluate the effects of driver behaviour on vehicle reliability
Thanks for your attention....

ANY QUESTIONS?