The role of driving simulators in electric vehicle research and development

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Contents

- About AMAP
- 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

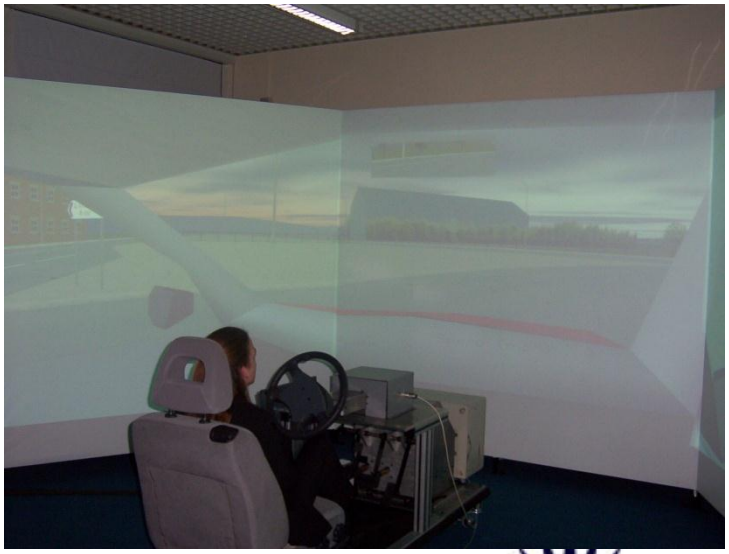
- AMAP is active in a number of projects in:
  - Ultra Low Carbon Vehicles
  - Digital Manufacturing
  - Reliability and Condition Monitoring
  - Industrial Maintenance and Efficiency

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

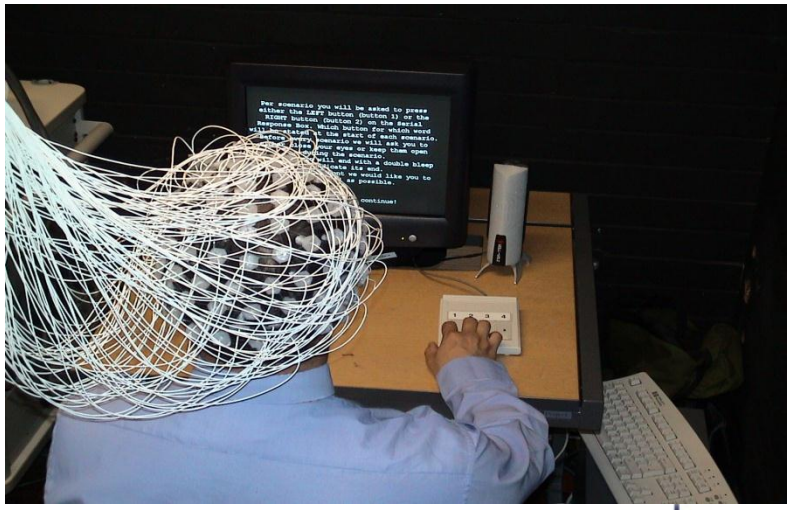


Applications

- 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

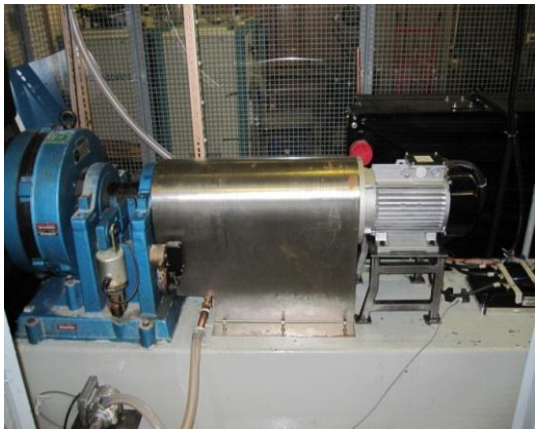
Examples of EV projects

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.

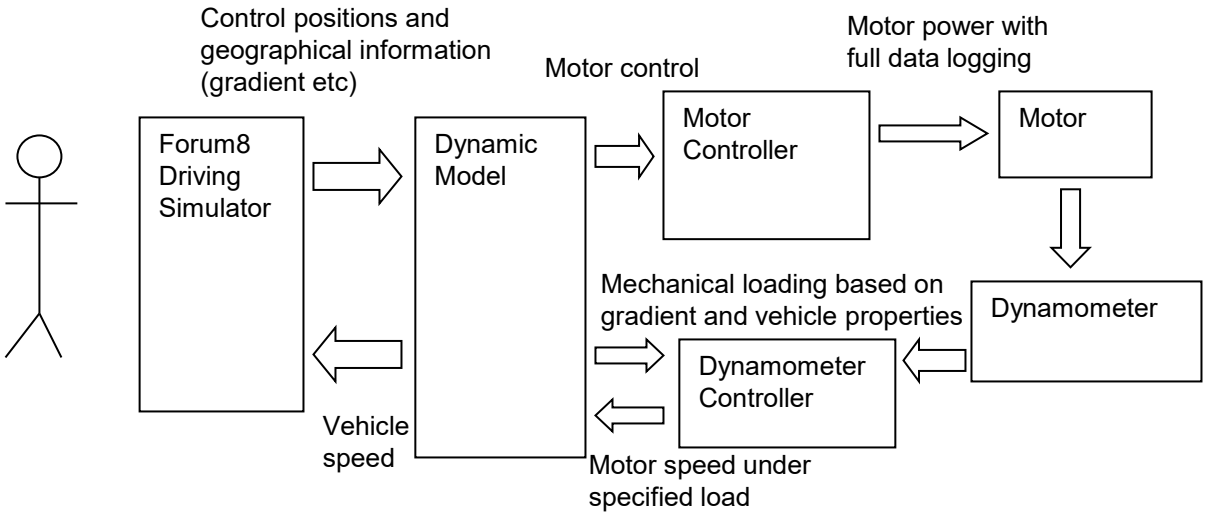
Driving Simulator Applications: Dynamometer Interconnection

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



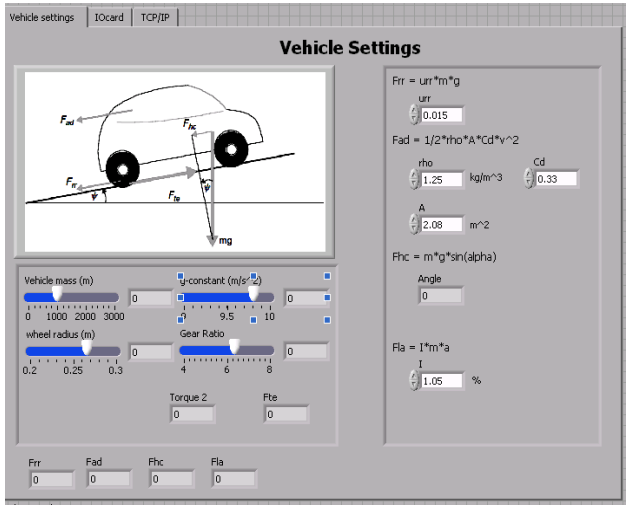
Driving Simulator Applications: Dynamometer Interconnection

- We are now working towards inteconnection between the driving simulator and the dynamometer



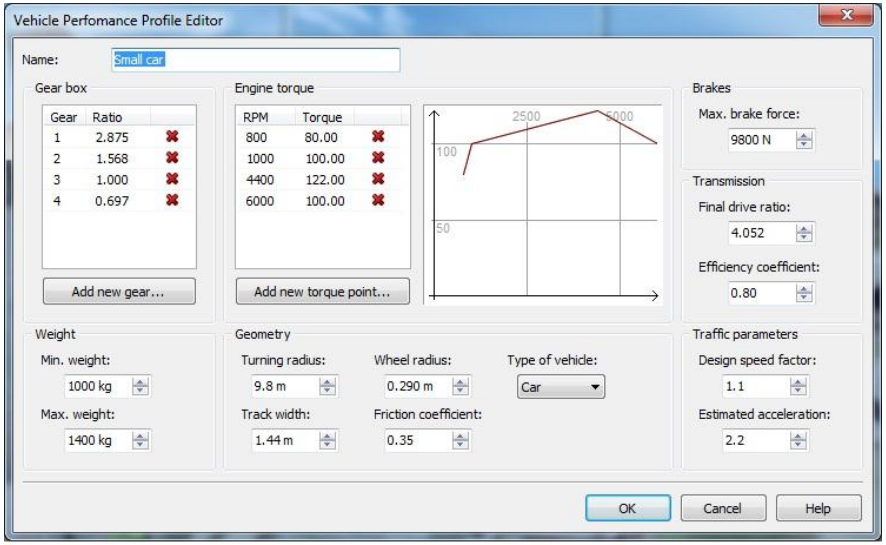
Driving Simulator Applications: Dynamometer Interconnection

- The vehicle's physical properties can be modified to suit the application



Driving Simulator Applications: Vehicle models

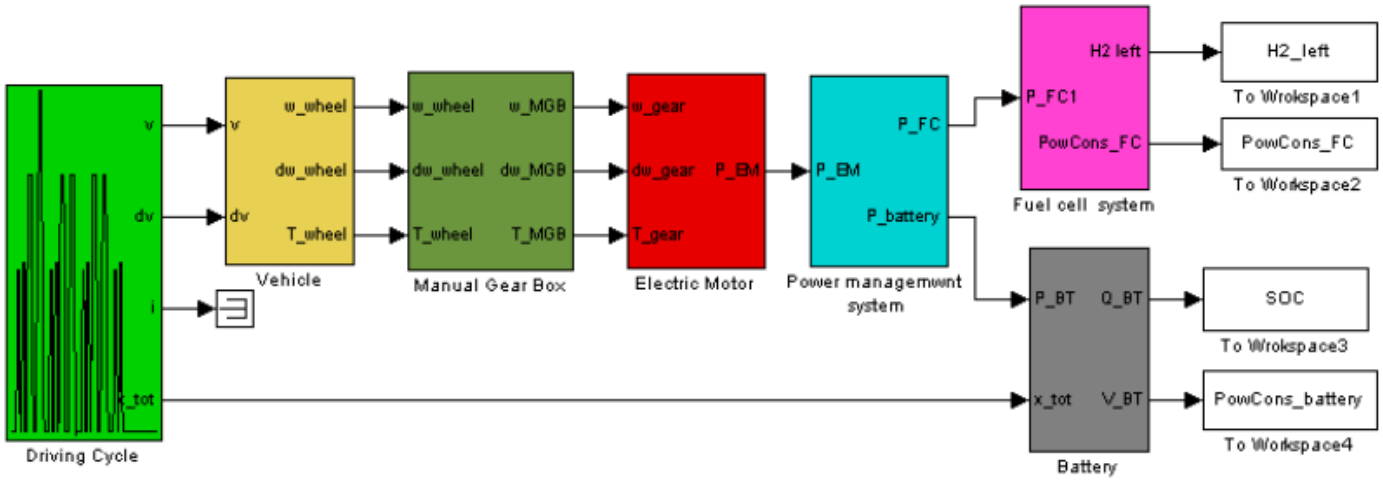
- The Forum8 UCWinRoad software provides a detailed Internal Combustion Engine Model



- 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

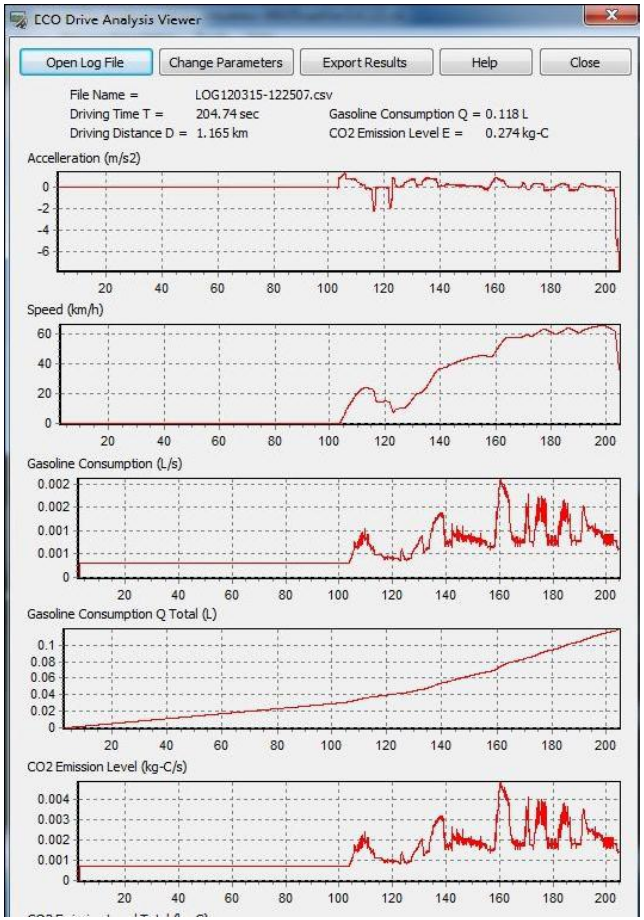
- Integration of simulator with MATLAB/Simulink models for human in the loop evaluation



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.

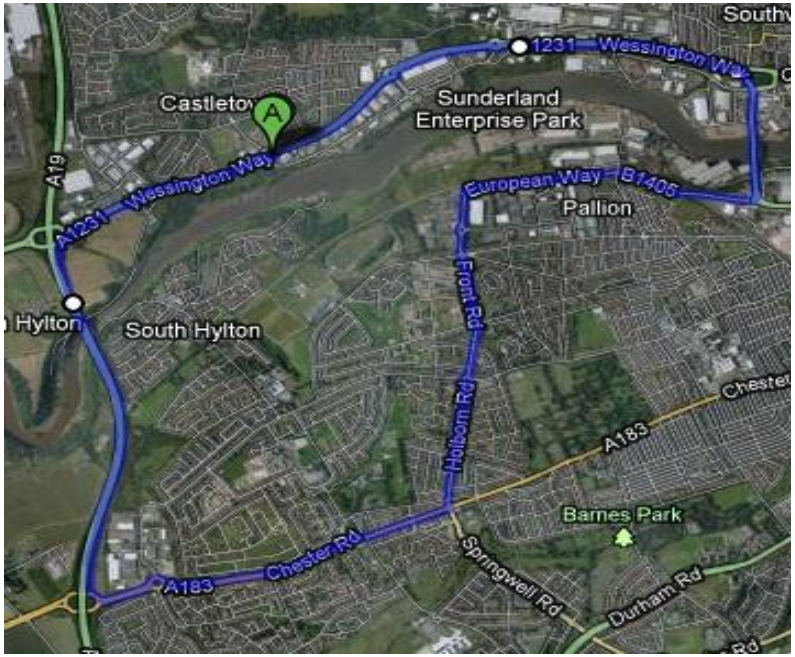
Eco driver training: DROPLET



- 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

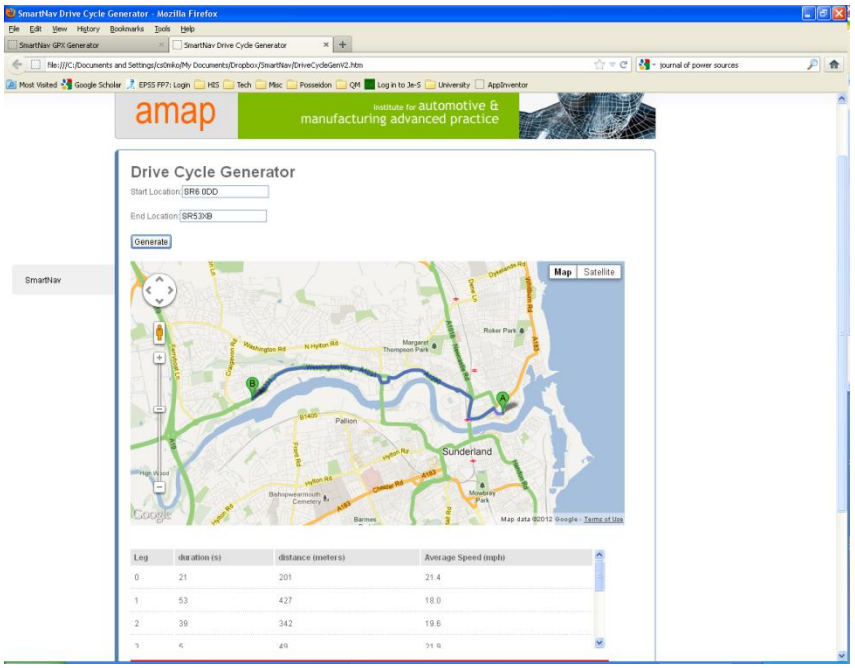
Supporting developments: creation of bespoke routes

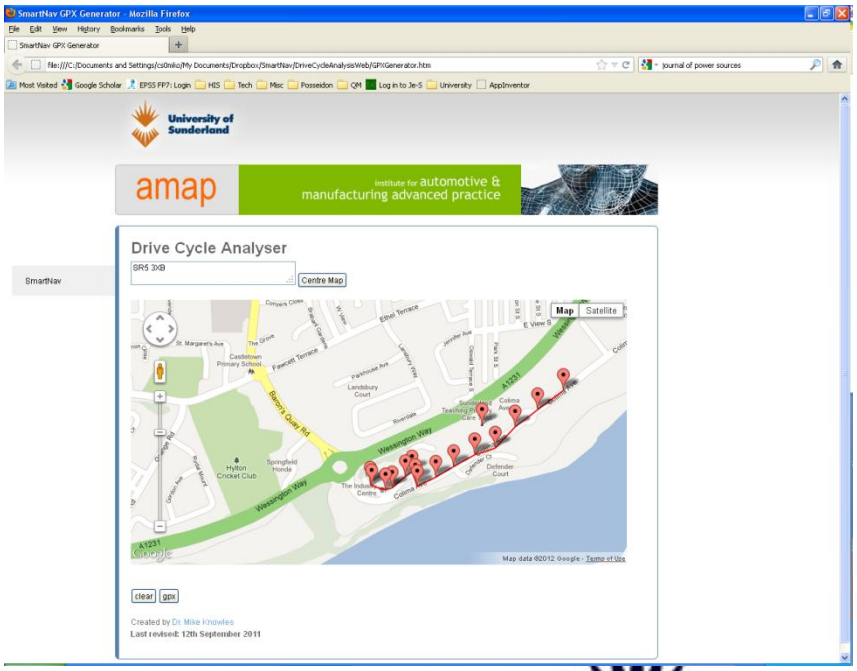
- In order to evaluate vehicles and hardware we have a local test route which comprises three distinct driving styles.
- We are currently working towards creating this route in the simulator



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?