Completed PhD Projects

Driver Re-engagement

Student: Samson Palmer

Project Summary:

'Driver Re-Engagement with Autonomy: Managing variable levels of delegated control'
The project is focused on looking at the delegation of authority between driver and autonomous vehicle from a human factors perspective, and using modern brain imaging techniques to assess higher cognitive functions during these situations.

- Validation of fNIRS as a methodology
- Demonstration of greater sensitivity of prefrontal cortical activity
- Method of ensuring transparency in Human-Autonomy Partnership

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Study of Battery Ageing

Student: Richard Stocker

Project Summary:

The project is looking into the ageing that occurs in Li-Ion cells with cycling. It aims to understand the reasons behind the ageing, and the key influential factors in how cells are used and designs that affect this. It is with mainly an automotive focus, and the objectives are to develop testing methodologies, simulation models and control strategies that can be used to better predict cell ageing, and also to prolong lifetime of Li-ion cells during automotive usage.

- Design of Experiments with Ageing Testing
- Relaxation pulse fitting for impedance evaluation
- Equivalent Circuit Distributed Electrical Model
- Incremental Capacity Analysis Stoichiometry Evaluation Algorithm
- Frequency Domain Impedance Algorithm (Ohmic and Dynamic) and time domain impedance evaluation algorithm
- Battery ageing model

Scenario-based Testing using Gaussian Process

Student: Felix Batsch

Project Summary:

- The research focuses on the validation of automated vehicles through simulation. Simulation can be used from early development stages onwards and is therefore a powerful tool to ensure the safety of future automated vehicles.
- Proof-of-concept one-click simulation agnostic test pipeline implemented in software toolchain
- Novel implementation of treed Gaussian Process models
- Framework for optimisation scenario-based testing using machine learning

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Pedestrian Pose Generation for Scenario-based Testing using GANs

Student: James Spooner

Project Summary:

The project is aiming to create pedestrian behaviour models using existing dashcam footage and pose analysis software. The pedestrian models will be implemented in Simulation software to test the functionality of ADAS & Autonomous Driving.

- Method for generation of single and temporal series pedestrian poses with accurate biofidelity using Generative Adversarial Networks (GANs)

- Novel dataset for pedestrian scenario generation derived from JAAD, Caltech (and Daimler for non-commercial purposes)

Download there Pedestrian Dataset here

Towards a Systematic Security Evaluation of the Automotive Bluetooth Interface

Student: Madeline Cheah

Project Summary:

The investigations in this thesis centre around the implementation of Bluetooth technology on vehicles. This is because Bluetooth is a pervasive interface and was therefore chosen for study because of the potential negative impact should it be compromised.

- Framework for systematic evaluation
- Dataset for automotive Bluetooth threat intelligence
- Proof-of-concept software tooling
- Classification of evidence in a security assurance case
- Methodology for formalisation of empirical penetration testing

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Systematic Vehicle Evaluation

Student: Milena Kukova

Project Summary:

- Model modelling relationship between vehicles, their attributes, customer responses and influences on those responses
- New customer journey model
- Comprehensive list of vehicle attributes and a method for calculating attribute importance
- More accurate vehicle classifications

Novel Hybrid Methodology for Structural Optimisation

Student: Alexis Wilson

Project Summary:

- Evaluation of commercial topology optimisation algorithms
- `Hybrid Option Parameters' implemented in Microsoft PowerShell
- Demonstration of advantages of simultaneous linear and non-linear optimisation

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A CAN Fuzz Testing Methodology for Automotive Security

Student: Daniel Fowler

Project Summary:

A fuzz testing methodology to increase automotive cyber-security resilience:- The increasing number of connected computational components in a vehicle enlarges the attack surface for malicious agents. To ensure a degree of resilience against remote attacks, manufacturers must perform cyber-security tests and audits. SAE J3061 regards fuzz testing as part of the testing regime, yet there little is available on how to apply fuzz testing to vehicles. This research addresses the application of fuzz testing to Controller Areas Networks and attached components.

- Prototype automated CAN fuzzing tool implemented in C
- Demonstration of fuzz testing and its effectiveness for automotive cybersecurity
- Methodology for addressing combinatorial explosion in fuzz testing
- Method of attack using configuration variation of ECU bitrates

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Ride Comfort Evaluation

Student: Maciej Cieslak

Project Summary:

- Artificial Neural Network based model for ride comfort evaluation along with the verification and validation of the model
- Demonstration of feasibility of using biometric measurement for ride comfort studies

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First and Last Mile Mobility with Human-centred Design

Student: Joscha Wasser

Project Summary:

- Key design factors for first and last mile mobility vehicles with design recommendations
- Novel comfort model
- Benchmark of approaches and design philosophies of first and last mile vehicles
- MiCAR concept and design
- Mixed-reality simulation

Cloud Computing Based Adaptive Traffic Control and Management

Student: Pawel Jaworski

Project Summary:

The project aimed to simultaneously improve traffic flow and driver satisfaction in urban and suburban areas by reducing average journey times, energy consumption and carbon emissions as well as reducing the amount of stops required to be made by the driver when traversing an urban road network. To achieve this the following objectives were addressed.

- Identify the criteria used to evaluate traffic management schemes.
- Investigate existing traffic management schemes and determine the most effective or most promising approaches. Examine their advantages and disadvantages and determine how they can be improved.
- Design an improved traffic management scheme to address the identified weaknesses of existing

methods.

- Design and develop the ITS-Cloud, a robust, distributed and scalable execution platform on which the traffic management applications can be deployed.
- Design and develop a simulation tool that is integrated with the ITS-Cloud and is capable of performing accurate traffic simulations and cooperate with the developed traffic management applications.
- Design and develop all the system components and applications of the Cloud based Traffic Management System (CTMS).
- Validate the new traffic management methods using the traffic simulator

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Dependability Assurance for Autonomous Vehicle Safety

Student: Luis-Pedro Cobos Yelavives

Project Summary:

The project aims to find a way to show how dependable vehicle assurance is. During the project a method has been developed that takes the aspects of Classical Safety (active & Passive), SOTIF (Safety of the intended function), Functional Safety, and Cybersecurity. The developed method uses the structure of GSN (Goal Structuring Notation) in combination with ADT (Attack Defence Trees) and challenges every claim, evidence and argument with inductive logic to reduce bias. So far there are 2 examples and a demonstration of the method

- The traffic Signal Recognition System
- AI driving
- Pilot Demonstration.
- Safety and Security Updates of a safety Critical Function like the Airbag
- Test Bench of Updates
- Ecu Analysis

Machine learning generation of attack trees

Student: Kacper Sowka

Project Summary:

The ultimate objective of this research is to produce a comprehensive machine learning supported attack tree generation methodology for the automotive cybersecurity domain. A principal aim is to explore how such a procedure could be utilised in practically viable cybersecurity assurance initiatives within the automotive industry, particularly in relation to the recently published ISO/SAE 21434 standard for automotive cybersecurity and UNECE Regulation 155. Of particular interest are methods for the encoding of salient cybersecurity critical information into individual vulnerabilities and the training of a machine learning model which can discern the relationship between two given vulnerabilities or weaknesses.

- Design of generation methodology
- Implementation of methodology with an automotive relevant example
- Sourcing of dataset to train machine learning models
- Comprehensive validation strategy determining the performance of the proposed methodology