This project is co-financed by
the European Union and the Republic of Türkiye.

OPINA

OPINA & ISTANBUL OKAN UNIVERSITY

Cooperation for M.Sc. Program in Automotive Mechatronics and Intelligent Vehicles

ISTANBUL OKAN UNIVERSITY

Open Innovation Autonomous Vehicle Development and Testing Platform Project

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EAST MARMARA DEVELOPMENT AGENCY

TESİD

yasad

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Automotive Mechatronics and Intelligent Vehicles M.Sc. Program

Program Description

Autonomous vehicles have the potential to significantly change future mobility and the automotive industry. Autonomous vehicles are a multidisciplinary field (Electrical-Electronics Engineering, Computer Engineering, Automotive Engineering) that requires in-depth knowledge. Automotive Mechatronics and Intelligent Vehicles Master's Program (with thesis) provides the industry with the opportunity to develop the necessary systems for autonomous driving by using current technologies, scientific innovations, and advanced laboratory tools. In addition, it provides students with the theoretical and scientific foundations, Ph.D. studies, and the opportunity to work in the scientific field.

Course Structure

The program covers the following topics:

- Intelligent Sensors and Control for Autonomous Systems
- Automotive System Safety & Cybersecurity
- Connected Vehicles
- Modelling, Simulation and Test Methods for Advanced Driver Assistance Systems
- Traffic Management Using Connected Autonomous Vehicles
- Artificial Intelligence for Autonomous Systems
- Machine Intelligence and Data Science
- Automotive Embedded Systems

Prerequisites

- Work experience in the automotive field,
- Bachelor's degree in Electrical-Electronics Engineering, Mechatronics Engineering, Automotive Engineering, Software Engineering or Computer Engineering Programming knowledge (Ideally C, C++ or Python)

Course Requirements

The program contains compulsory and elective courses each of which are 3 credits. Students must successfully complete 21 credits of courses and a thesis assigned by the program adviser.

Course Duration

Degree: Master of Science

Teaching Language: English

Programme Duration: 4 semesters

Assessment and Evaluation / Grading

During the M.Sc. Education, necessary technical information will be conveyed in accordance with the determined curriculum; groups formed from participants will discuss sample cases and perform sample applications using OPINA Laboratory Tools and Equipment. Participant performance will be continuously monitored throughout the training and evaluation will be made with the exam after the training.

Application

Mecidiyeköy Campus

Avni Dilligil Sok. No: 18 34394 Mecidiyeköy/İstanbul

Tel: 0 (212) 212 65 26 | 444 65 26

Tuzla Campus

Istanbul Okan University Tuzla Campus, 34959 Akfırat - Tuzla/İstanbul

Tel: 444 65 26 | 0 (216) 677 16 30

https://forms.okan.edu.tr/lisansustu-formu

info@opinaproject.com

Automotive Mechatronics and Intelligent Vehicles M.Sc. Program

Intelligent Sensors and Control for Autonomous Systems (42 hours, 3 Credits)

- Input/Output representation and PID control
- State-Space representation and equivalence to I/O
- Sensor fusion
- PID Control and Model Predictive Control (MPC)
- Integrator and double integrator
- Simulation of robot models (Euler method)
- Simulating autonomous systems and their environments
- MATLAB/Simulink and Robotics Operating System
- Sensing and navigation
- Encoders, odometry, IMUs

Automotive System Safety & Cybersecurity (42 hours, 3 Credits)

- Introduction to the importance of vehicle electronics safety and standards
- Examine regulatory frameworks and standards ISO 26262
- Study the roles & responsibilities of supply chain; OEM, Tier 1's, Tier 2's, etc.
- Systems engineering in the Automotive Industry: Study the automotive quality lifecycle
- Automotive systems design
- Study practical examples of redundancy, decomposition, error detection and correction at vehicle, module and circuit level
- Safety analysis methods - Hazard & Risk Analysis, FMEA & FMEDA
- Functional Safety vs. Safety of the intended function overview
- Introduction to the relevant legislative structures
- Cybersecurity concepts

Connected Vehicles (42 hours, 3 Credits)

- Vehicle Interactions such as V2V, V2I, V2R, V2N, V2P, I2I
- VANET, MANET, InVANET
- Routing Methodologies for vehicle interactions
- Virtual Understanding of the environment through sensor data
- In-vehicle digital maps and positioning technologies as sensing systems
- Limitations of GPS
- Basics of Mobile Wireless Communication Basics
- DSRC, C-V2X and C-ITS

Modelling, Simulation and Test Methods for Advanced Driver Assistance Systems (42 hours, 3 Credits)

- Overview of modern modelling methods and tools for the development of advanced driver assistance systems
- Requirements for real-time modelling regarding accuracy, operating range, simulation speed, handling/knowledge, robustness, information content and portability
- Inductive vs. deductive modelling, approximation capability of a model, regarding local / global as well as static and dynamic mapping
- Hybridization of model structures
- Simulation configuration from model to hardware in loop (MIL to HIL)
- V-Model in advanced driver assistance systems
- ADAS Camera Modelling
- Overview of test and simulation methods methods and tools for the development of advanced driver assistance systems
- Modern Modelling and Simulation Techniques for ADAS
- Representation and Analysis of Modelling and Simulation Results
- Overview of Neural Networks & ADAS for modelling and simulation

Traffic Management for Connected Autonomous Vehicles (42 hours, 3 Credits)

- Intelligent Transportation Systems, Traffic Safety, Ramp Metering, Real-Time Traffic Control, Incident Management, Work Zone Traffic Management, Advanced Public Transportation Systems
- Traffic Flow Modeling and Simulation
- Connected/Autonomous Vehicles, EV
- Micromobility, mobility as a service (MAAS)
- Smart and Sustainable Transportation Systems
- Effects of Climate Change, Resilience of Transportation Systems
- Circular Economy Implementations in Transportation Engineering
- The Use of Big Data to Address Challenges in Mobility, Safety, Equity, Sustainability in Multimodal Transportation Systems
- Airport Ground Access and Egress Modeling
- Travel Behavior

Artificial Intelligence for Autonomous Systems (42 hours, 3 Credits)

- Target detection, identification, recognition, and tracking using multiple heterogeneous sensors from cooperating AS, including accuracy assessment and uncertainty reduction for these applications.
- Introduction to AI for AS with overview of AS sensors and imaging
- AI Algorithms: Unsupervised Learning
- Unsupervised Learning
- AI algorithms: Supervised Learning – SVM and Neural Networks
- Supervised Learning
- AI Algorithms: Supervised Learning – Deep Neural Networks
- Deep Learning
- Automated Reasoning

Machine Intelligence and Data Science (42 hours, 3 Credits)

- An overview of autonomous vehicles technology
- System architecture
- Localization
- Sensing and perception
- Motion planning in complex environments
- A general overview of AI systems
- Data science basis for machine intelligence
- Understanding experimental data and fitting
- Clustering and classification
- Deep learning systems
- Introduction to neural networks
- Deep learning neural networks
- Reinforced learning
- Supervised and unsupervised learning
- Convolutional neural networks

Automotive Embedded Systems (42 hours, 3 Credits)

- Overview of the different embedded systems in the context of automotive applications
- A case study of an automotive electronic control unit.
- Overview of robustness, including covering aspects such as faults/failures
- reliability/dependability and safety related automotive embedded systems
- Main features and requirement for automotive electronics
- Parasitic components in electronics circuits, environmental and operational conditions, aging
- Analysis and simulation of parasitic components and their effect on circuit response
- Automotive software development and documentation
- Automotive software robustness including investigated coding best practices
- Automotive standards and guidelines (MISRA C and ISO 26262)
- Introduction to version control
- Models for developing complex embedded systems using V-model and Model Based Design (MBD)

OPINA Infrastructure

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In 2020, the Open Innovation Autonomous Vehicle Development and Testing Platform Project (OPINA), was established through the scope of the Competitive Sectors Program by the Ministry of Industry and Technology of the Republic of Turkey and the Project implemented by İstanbul Okan University Transportation Technologies and Intelligent Automotive Systems Application and Research Center (TTIS). OPINA is co-funded by the European Union and the Republic of Turkey and serves to combine and extend the services of E-HIKE and E-HIKE Link.

The aim of OPINA is to become one of the leading CCAM Excellence Centers of Europe.

The program covers the following tools and equipment,

- Autonomous Vehicle Software and Artificial Intelligence Simulation Tool
- Autonomous and Communicating Vehicle Hardware Simulation Tool (dSPACE)
- Radars (Long and Short Range), Lidars
- Stereo Cameras
- Specific Cameras and Lenses for Simulation Hardware Tool and Sensor Fusion Systems
- GNSS (GPS, Wi-fi, Bluetooth)
- Miniature Inertial Sensors
- Servers, Power Laptops, Display Screens
- Sensor Fusion System
- CAN Analyzer Tool
- Portable Automotive Grade Computer System
- Automotive ECU
- V2X (Vehicle-to-everything) Communication Modem
- Autonomous Vehicle Model and Software Simulation Tool (MIL/SIL)
- HD Real-time Map Tool
- ISO26262 Compliant Project Management Tool
- Automotive Software and System Requirements and Development Management Tool
- Open Embedded Software Development Tool
- Electrical and Gasoline/Diesel Vehicles
- IPG Truckmaker for Lab Based MIL/SIL Simulation
- dSPACE Based Hardware in The Loop (HIL) Testing Environment
- Canoe Based Functional Testing
- Bench Marking Analysis for Autonomous Applications Based on AVRS (Driver in The Loop Testing)
- In-Vehicle System Testing

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