Welcome at the TU/e Graduate School Event

Master Automotive Technology (AT)

Mauro Salazar, Assistant Professor
Today’s program:

- Presentation Master’s & pre-Master’s program (30 min)

- Time for questions (30 min)
CONTENT
MASTER AUTOMOTIVE TECHNOLOGY (AT)

• Brainport region
  • AT: why?
  • AT: what?
  • After graduation
  • AT Pre-Master program
  • Admission & Application
Top-ranking Dutch university

The Netherlands → Brainport → Eindhoven

Accounts for 23.1% of total Dutch private R&D expenditure*

Student growth

<table>
<thead>
<tr>
<th>Year</th>
<th>BSc</th>
<th>MSc</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>5,591</td>
<td>3,608</td>
<td>9,199</td>
</tr>
<tr>
<td>2019</td>
<td>7,501</td>
<td>4,750</td>
<td>12,251</td>
</tr>
</tbody>
</table>

Engineers for the future

More than 93 nationalities

- 86% Dutch
- 14% International

12,251 total number of students

- 86% Dutch
- 14% International

92% of the graduated students finds a job within 6 months. Nationwide this is 89%

3,298 total degrees awarded

- 1,441 BSc
- 1,455 MSc
- 120 PDEng
- 282 PhD

59,341 total number Alumni

- 83% Male
- 17% Female
Brainport: the beating technological heart of Europe
The TU/e campus covers an area of 75 hectares

Ecosystem and characteristics
- 47 new patent applications
- 7 patents filed by third parties
- 29 provisionals converted
- 35 transferred via a transfer or license
- 2747* Scientific publications

International working environment
- 3,301.3 Total staff (fte)
- 2,122 Research staff (fte)
- 64.3% Dutch
- 35.7% International
- 61.5% Male
- 38.5% Female
- 154 Full professors
- 138 Part time professors
- 144 Associate professors
- 300 Assistant professors
- 1,572 PhD fellows

Rankings:
- CWTS Leiden Ranking 2020: TU/e no. 4 in industry cooperation
- Times Higher Education: 2021 no. 187 of 1000
- QS-Ranking 2021: no. 120 of 1003
CONTENT
MASTER AUTOMOTIVE TECHNOLOGY (AT)

• Brainport region
• **AT: why?**
• AT: what?
• After graduation
• AT Pre-Master program
• Admission & Application
Why Automotive Technology at TU/e?

• According to the “Keuzegids Masters 2021”, the Master’s program AT was among the five master programs of TU/e with the best prognosis for the labor market.

• Unique Master’s program in the Netherlands

• Good contacts with Brainport industries

• International classroom (>30% international students)

• Interdepartmental program (5 departments are participating in the program)
Future in mobility

• No pollution
• Sustainable energy sources
• No congestion

• Improved safety
• Ease of use
• High-tech system
Focus on smart & sustainable mobility

Automotive technology is more than just one car:

- Cooperative vehicle control
- Autonomous and cooperative driving vehicles
- Human-technology interaction
- Driver assistance systems
- Vehicle dynamics control
- Smart grids
- Sensing & mapping
- Functional architecture and safety
- Powertrain design & control

All these topics are connected!
Systems engineering perspective

• Understanding of the relations between disciplines
• Considering all aspects of the vehicle
CONTENT
MASTER AUTOMOTIVE TECHNOLOGY (AT)

- Brainport region
- AT: why?
  - **AT: what?**
  - After graduation
  - AT Pre-Master program
  - Admission & Application
AT program

- Duration: 2 years (120 EC)
- Time of entry international students: September
- Degree: Master of Science (MSc)
- Language: English
Specialists from many fields involved

Interdisciplinary cooperation between 5 departments:

• Electrical Engineering
• Industrial Engineering and Innovation Sciences
• Industrial Design
• Mathematics and Computer Science
• Mechanical Engineering
Program overview

1st year
- Core program (30 EC)
- Specialization courses (15 EC)
- Free electives (incl. homologation, 15 EC)

2nd year
- Internship (15 EC)
- Graduation project (45 EC)
AT – core program

- Vehicle dynamics (ME)
- Automotive human factors (IE&IS / ID)
- Real-time software system engineering (M&CS)
- Powertrains (ME/EE)

Automotive systems engineering project (CBL, 10 EC)
Automotive systems engineering project

Autonomous Driving and Parking of Trucks in Distribution Centers and integrating Functional Safety

Multidisciplinary project team (+/- 6 members) in collaboration with industry
# Specialization in the program

1st year

- Core program (30 EC)
- Specialization courses (15 EC)
- Free electives (incl. homologation, 15 EC)

2nd year

- **Internship** (15 EC)
- **Graduation project** (45 EC)
Specialization themes: Smart Mobility

Autonomous Driving

Embedded Software

Vehicle Dynamics Control

Automotive Human Factors
# Smart Mobility: specialization themes & sections

<table>
<thead>
<tr>
<th>Autonomous Driving &amp; Embedded Software</th>
<th>Vehicle Dynamics Control</th>
<th>Automotive Human Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model Driven Software Engineering (M&amp;CS)</td>
<td>Dynamics &amp; Control (ME)</td>
<td>Human Technology Interaction (IE&amp;IS)</td>
</tr>
<tr>
<td>Interconnected Resource-aware Intelligent Systems (M&amp;CS)</td>
<td></td>
<td>Future Everyday (ID)</td>
</tr>
<tr>
<td>Signal Processing Systems (EE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic and Embedded Systems (EE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Systems Technology (ME)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamics &amp; Control (ME)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Specialization themes: Sustainable Mobility

- Future Fuels
  - $E_{fuel}$
  - $m_{fuel}$

- Internal Combustion Engines
  - $P_{engine}$

- Automotive Materials
  - $P_{request}$

- Electric Machine
  - $P_{electric}$
  - $P_{EM}$

- Electric and Hybrid Vehicles and Transmission
  - $E_{battery}$
## Sustainable Mobility: specialization themes & sections

<table>
<thead>
<tr>
<th>Internal Combustion Engines &amp; Future Fuels</th>
<th>Electric &amp; Hybrid Vehicles and Transmissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power &amp; Flow (ME)</td>
<td>Electromechanics and Power Electronics (EE)</td>
</tr>
<tr>
<td>Control Systems Technology (ME)</td>
<td>Control Systems (EE)</td>
</tr>
<tr>
<td></td>
<td>Control Systems Technology (ME)</td>
</tr>
<tr>
<td></td>
<td>Dynamics &amp; Control (ME)</td>
</tr>
</tbody>
</table>
Year 2: Internship & Graduation Project

Internship: 15 EC | Graduation project: 45 EC

• Independent work
• Model, analyse, design new automotive (sub)systems
• Explore new research questions
• Within university or in cooperation with industry
Examples of graduation projects

• “Development of a generic hybrid energy management strategy for CO2-declarations”
• “Object tracking for autonomous and cooperative driving”
• “Maximization of Brake Energy Recuperation with Minimal Impact on other Drive Train Components”
• “Development and validation of a multibody model of a Renault Twizy”
Examples of graduation projects

• “Research and Development of Human Machine Interface (HMI) for future long-haul trucks”
• “Guidelines for transition of control in autonomous vehicles”
• “Vehicle stability analysis of a solar car: Stella Lux”
Olaf Borsboom

B.Sc. Automotive at TU Eindhoven
  • Interest in applying physics in an object of every-day use

M.Sc. Automotive Technology with the Control Systems Technology group
  • No specialization theme, but a tailored package of CST courses
  • Mixture of control theory, optimization and automotive applications

My experience
  • Broadly oriented automotive engineer
  • With a “systems”-thinking approach on a project basis
  • Placing the car as an object in society
  • Tailored education program
My internship

Automatic test case generation of Hardware-in-the-Loop testing of automatic transmissions for passenger cars

At AVL in Graz, Austria
My Master thesis

A framework to efficiently compute the achievable lap time of an electric race car with different transmission technologies and component sizes

Student team InMotion

Comparing a fixed-gear with a CVT

Convex model

Optimization
Alessandro Locatello - Master Thesis

Time-optimal Control of Electric Race Cars under Thermal constraints

Modelling

Optimization

\[
\min \int_0^S \frac{dt}{ds}(s) \, ds
\]

s.t. ...

30  TU/e Graduate School Event 2022 – MSc Automotive Technology
Alessandro Locatello

B.Sc. Mechanical Engineering, Padova University, Italy

- Interest in electric machines
- TU/e M.Sc. AT towards electrical engineering EPE

Broad study program

- T skilled engineer
- Broad basics - felt the need to integrate

Experience

- Specialization shift, re-arranging courses CST
- Great student support (Corona times)
- Internship and Thesis (diversity of environments)
Coaching

- Mentor program: Full, associate or assistant Professor
- Student mentor
- Academic advisor
Facilities

- Automotive Technology lab
- Other labs:
  - engine test cells
  - fixed base driving simulator
  - digital twin lab
- Automotive Campus Helmond
Selection of TU/e student teams

- Solar Team Eindhoven
- University Racing Eindhoven
- ATeam
- TU/ecomotive
- Storm
- InMotion
- FAST
I was looking back and realized: It used to be all men in games.
Master Automotive Technology in a nutshell

• Focused discipline with a system engineering perspective
• Interdepartmental
• Broad basis and a specialization within a section in one of the involved departments
• Fixed core program
• Integration project
• Professional skills: academic writing, presentation, project management
• International environment (>30% int. students)
• Automotive laboratory
CONTENT
MASTER AUTOMOTIVE TECHNOLOGY (AT)

• Brainport region
• AT: why?
• AT: what?
• After graduation
• AT Pre-Master program
• Admission & Application
After graduation

- PDEng Automotive systems design
- PhD project
- Job in industry
TU/e Graduate School – shape your own future!

Bachelor College

Graduate School

MSc
Master of Science

BSc
Bachelor of Science

3 years

2 years

PDEng
Professional Doctorate in Engineering

PhD
Doctor of Philosophy

4 years
Work after M.Sc. Automotive Technology

New challenge: Altran Technologies, Junior consultant & engineer

Seek your opportunities:
- Internship at TNO Helmond
- Part Time job at Diverto Technology B.V
- (Others: thesis projects, student teams)

They were looking for Electrical Engineer
- B.Sc. & M.Sc. Mechanical engineering BUT 3 courses on electrical engineering
- “I value ambition as much as experience”
- Soft skills, only if you want to
My PhD project

NEON Research Program

• A group of 30+ PhD students with a multidisciplinary approach
• Accelerating the way to zero emission energy and mobility

My project:

• Work package: Electric mobility
• Multifidelity methods for electric powertrain systems design
CONTENT
MASTER AUTOMOTIVE TECHNOLOGY (AT)

• Brainport region
• AT: why?
• AT: what?
• After graduation
• **AT Pre-Master program**
• Admission & Application
Pre-Master Automotive Technology

- Duration: 1 years (30 EC)
- Time of entry: September
- Language: English

Why?
- Eliminate knowledge gaps

What?
- Program of 30 EC, to be achieved within one year
- Focus on mathematics (10 EC)
### AT pre-Master program 2021-2022 (30 EC)

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Course Code</th>
<th>Course Name</th>
<th>EC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2DL60</td>
<td>Linear Algebra</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>2WBB0</td>
<td>Calculus variant 2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4CB00 [1]</td>
<td>Signals and Systems</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>2DL40</td>
<td>Advanced Calculus I</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>5LIU0 [1]</td>
<td>Premaster linear systems, signals &amp; control</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4DB00</td>
<td>Dynamics and control of mechanical systems</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4GB10</td>
<td>Combustion Engine</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5APA0 [2]</td>
<td>Power Electronics</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>2IS50 [2]</td>
<td>Software Development for Engineers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5AIB0 [2]</td>
<td>Sensing computing &amp; actuating</td>
<td>5</td>
</tr>
</tbody>
</table>

**Compulsory courses** 25 EC

- 2DL60 Linear Algebra
- 2WBB0 Calculus variant 2
- 4CB00 Signals and Systems
- 2DL40 Advanced Calculus I
- 5LIU0 Premaster linear systems, signals & control
- 4DB00 Dynamics and control of mechanical systems
- 4GB10 Combustion Engine
- 5APA0 Power Electronics
- 4PB00 Heat and flow
- 2IS50 Software Development for Engineers
- 5AIB0 Sensing computing & actuating

**Elective course** 5 EC

- 2 Students have to choose one of these 2 compulsory courses
- 2 Students have to choose one of these 4 elective courses

#### Mandatory trainings
- RSI (healthy use of laptop)
- Safety & environment

#### Recommended
- MATLAB training

---

1. Students have to choose one of these 2 compulsory courses
2. Students have to choose one of these 4 elective courses
Difference WO (TU) & HBO (UAS)

University of technology:
• **Developing** new technology and design methods to solve technological problems
• Education focuses on concepts and their implications
• Guaranteeing performance of controlled and engineered systems

University of applied science:
• **Applying** existing technology and design methods to solve technological problems
• Education focuses on practical application
How to prepare during your bachelor’s program?

• A pre-master’s program is more work than one might think. You must be willing to work hard.

• It is not advised to do the pre-master in combination with a part-time job in industry.

• Subscription for a pre-master via Studielink before **May 1st**.

• required minimum level of mathematics: pre-university (VWO) mathematics B or [TU/e mathematics B test](#) completed before September 1st

• required minimum level of English proficiency: pre-university (VWO) level English or [English language proficiency test](#) completed before September 1st
CONTENT
MASTER AUTOMOTIVE TECHNOLOGY (AT)

- Brainport region
- AT: why?
- AT: what?
- After graduation
- AT Pre-Master program
- Admission & Application
Admission with a BSc degree in:

- Advanced Technology (pre-mechanical engineering track)
- Aerospace Engineering
- Applied Physics
- Electrical engineering (Automotive included)
- Marine Technology
- Mechanical engineering

Prior education needs to be of sufficient academic level and quality to be able to complete this Master's degree program.
Admission via pre-master’s program

Direct admission (HBO):

- Mechanical engineering
- Automotive
- Applied physics
- Electrical engineering
- Aerospace technology / aviation
- Mechatronics

Tailor-made pre-master’s programs for other (university + HBO) diplomas via admission committee Admission.Mech@tue.nl
APPLICATION MASTER PROGRAMS

For Dutch students:
• More information about admission: www.tue.nl/admission
• Application via http://www.studielink.nl/
• Questions: studeren@tue.nl

For international students:
• Check the requirements for admission via www.tue.nl/admission
• Apply at the online application form - Deadline: May 1st
• Application fee of €100 for each application (non refundable)
• Application procedure takes +/- 8 weeks
• You will be informed by email about the outcome of your application
• Questions: io@tue.nl
More information

Information:

• Master AT: https://www.tue.nl/en/education/graduate-school (info on Master’s program, curriculum, interviews with students and alumni)

Questions:

• Content program: me.studyinformation@tue.nl