Control Systems Technology

CST info for new master students 2020-2021

Maarten Steinbuch    Maurice Heemels
Control Systems Technology

**Disciplines**
- systems and control theory
- mechanical design / mechatronics
- systems engineering

**Applications**
- advanced motion and high-tech systems
- robotics for care/cure/agro-food
- automotive power trains & smart mobility
- energy systems

KPIs:
- 55 PhDs
- 70 MSc/year
- 1.3 Journal/year
- 2.5 M€/jaar funding
CST People and subprogrammes

- Model-based Control, Learning Control, Identification and Design of Motion Systems
- Cyber-Physical Systems of Systems
- Robotics for Care, Cure & Agro-food
- Automotive Powertrains & Smart Mobility
- Control of fusion plasmas


Heemels, Antunes, Reniers, vd Mortel, Etman, v Beek, Chong, Fokkink, van Eekelen


Hofman, Salazar, *Silvas*, Willems, van Keulen, Huisman, de Jager

De Baar
CST’s mission:

Our mission is to develop new methods and tools in the area of Systems Theory, Control Engineering and Mechatronics.

The research focuses on understanding the fundamental system properties that determine the performance of mechanical engineering systems, and exploiting this knowledge for the design of the high-tech systems of the future.

Subprogrammes:
- Model-based Control, Learning Control, Identification and Design of Motion Systems
- Cyber-Physical Systems of Systems
- Robotics for Care, Cure & Agrofood
- Automotive Powertrains
- Control of fusion plasmas
Research disciplines

- Control of fusion plasmas
- Model-based control and identification systems
- Cyber-physical systems and systems engineering
- Mechanical design and robotics for care and care
- Automotive powertrains
- Vision of farming in the future: Multi-agent systems
Research disciplines in a nutshell

Automotive powertrains & Smart Mobility
• to find a cost-efficient balance between drivability and energy-efficiency
• technology, topology and control design for hybridization of automotive powertrains
• Automated driving / AGV
• Control of fusion plasmas
• advanced control methods of ITER, a nuclear fusion reactor, for magneto-hydrodynamic instabilities and control of distribution of the current density in the plasma

Mechanical design and Robotics for care and cure
• statically determined mechanical design of machines and instruments for robotic surgery systems and semiconductor industry
• advance the state-of-the-art in robotics in health-related applications
• investigating the cognitive abilities of domestic service robots
• world-class design of high-performance robots (MidSize Turtle, Amigo, Sofie, PRECEYES, Colibri, etc.)
• control synthesis methods for haptic master-slave systems that can deal with uncertainty

Model-based control, learning and identification of motion systems
• Using multiple additional actuators and sensors to actively compensate for deformations in a future reticle stage (FFR in lab)
• Identifying models of complex high-order dynamics and massive MIMO systems for robust control
• Learning in machines: exploiting data-driven (machine) learning and models to (iteratively) learn to control to the limits of performance

Cyber-physical systems and Systems engineering
• foundations for distributed control of physical systems over shared communication networks and resource-aware (event-triggered) control
• fundamental developments in the area of hybrid systems that directly connect to the essential challenges in the NCS and CPS applications
Selecting a mentor

• Within 5 months each CST master student need to have a mentor
• Any scientific staff member can be a mentor
  • Excluding Maarten Steinbuch & Maurice Heemels (few)
  • Part-timers have (very) limited capacity
• Choose one and ask him/her if he/she wants to be your mentor
• Discuss courses, career stuff, other problems (your initiative)
• Mentor has to approve your list of courses
• Mentor has to sign your internship form (although mentor is not necessarily your internship supervisor)
• INFORM Asia van de Mortel and Secretary CST (CST@tue.nl) about your mentor
Selecting an internship

- Feel free to find an internship, but academic level needs to be appropriate
- List of “approved” (international) contacts available via Asia van de Mortel
- Any scientific staff member can be an internship supervisor
- Find an internship supervisor with appropriate expertise for your internship subject
- Possibly discuss with mentor, internship supervisor (if you have one)
- Hard to find an appropriate internship? Contact Asia van de Mortel and list what YOU already did to find an internship
- INFORM Asia van de Mortel and your internship supervisor about your internship
- Send the scan of the signed internship form to secretary CST (CST@tue.nl)
Selecting a master final project

- ALL final projects are only available through CST scientific staff.
- Do NOT contact companies etc. yourself to *find an assignment!*
- Find a thesis advisor (any scientific staff member).
- Asia van de Mortel has a portfolio of available MFPs (not complete).
- Thesis advisor may suggest a MFP.
- Hard to find an appropriate MFP? Contact Asia van de Mortel and list what YOU already did to find a MFP.
- INFORM Asia van de Mortel and thesis advisor about your MFP.
- Send the scan of the signed MFP form to secretary CST (cst@tue.nl).
- Be aware that some scientific staff members may have all MFPs filled in at certain times and therefore cannot accept you for an MFP.
- Be aware that your list of courses (esp. absence of certain courses) may be a reason not being accepted for an MFP.
MSc degrees:

- Master Systems & Control
- Master Automotive Technology
- Master Mechanical Engineering (DSD/CST)
  - MSE – manufacturing systems engineering track
  - AIES – artificial intelligence for engineering systems track
- Master Nuclear Fusion

Further practicalities:

- Info meetings @ start in CST
- Mentoring program
- Projects: Guidance by project coaches, regular meetings (permanent) staff employee
<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
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<tbody>
<tr>
<td>Control engineering</td>
<td>4CM00</td>
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<tr>
<td>System theory for control</td>
<td>4CM10</td>
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<tr>
<td>Engineering Optimization</td>
<td>4DM20</td>
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<tr>
<td>Hybrid systems and control</td>
<td>4CM20</td>
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<td>Advanced motion control</td>
<td>4CM60</td>
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<td>Embedded motion control</td>
<td>4SC020</td>
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<td>Supervisory control</td>
<td>4CM30</td>
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<td>Optimal control and dynamic programming</td>
<td>4SC000</td>
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<tr>
<td>Haptics</td>
<td>4SC040</td>
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<tr>
<td>Physical modelling</td>
<td>4CM40</td>
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<td>Application of Design principles</td>
<td>4CM50</td>
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<td>Advanced Full-Electric &amp; Hybrid Powertrain Design</td>
<td>4AT030</td>
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<tr>
<td>Advanced control for future HD powertrains</td>
<td>4AT070</td>
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<td>Control and operation of tokamaks</td>
<td>4SC010</td>
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<td>Control of magnetic instabilities in fusion plasmas</td>
<td>4SC030</td>
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<tr>
<td>Integrated System design</td>
<td>4CM70</td>
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<td>Learning Control</td>
<td>4SC070</td>
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Summarizing

CST group unites
• Science and fundamental (control) theory
• Applied research & design
• Society / Spin-offs

Highest quality standards
• Two latest int. research evaluations. Excellent highest possible scores (quality, productivity, viability and relevance: 5555)
• Recent bibliometric evaluation 3TU. CWTS Univ. Leiden: Control Systems Technology stands out in terms of impact.
Further information

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Thank you for your attention