DD2603 Geometric Robot Learning 7.5 credits

Geometrisk robotinlärning

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

The official course syllabus is valid from the autumn semester 2026 as decided by the faculty board decision The official course syllabus is valid from the autumn semester 2026 as decided by the faculty board decision HS-2025-1824. Date of decision 2025-10-07. Date of decision 2025-10-07

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Computer Science and Engineering

Specific prerequisites

Knowledge in basic machine learning, 3 credits, equivalent to completed course DD1420/DD2421 or completed exam modules (for example DD1420/KON1) within these courses.

Knowledge and skills in programming, 6 credits, equivalent to completed course DD1337/DD1310-DD1319/DD1321/DD1331/DD100N/ID1018/ID1022.

Knowledge in linear algebra, 7.5 credits, equivalent to completed course SF1624/SF1672/SF1684.

Knowledge in probability theory and statistics, 6 credits, equivalent to completed course SF1910-SF1925/SF1935 or completed exam module TEN1 within SF1910/SF1925/SF1935.

Intended learning outcomes

After passing the course, students should be able to

- use basic concepts from differential geometry in robotics
- use geometric machine learning algorithms
- use Riemannian optimisation algorithms in robot learning algorithms
- use geometric learning and control methods for simple mechanical systems
- discuss and evaluate the effect and limitations of geometric methods in connection with machine learning for robotics
- summarise current research topics in the field of geometric robot learning.

in order to

- be able to use geometric methods to solve problems in machine learning and robot learning
- be able to adopt new research methods for geometric robot learning, techniques and approaches.

Course contents

- Introduction to geometric robot learning, techniques, approaches.
- Basic concepts in differential geometry, manifolds of interest in robot learning.
- Fundamentals of learning on smooth manifolds.
- Imitation learning on smooth manifolds.
- Riemannian manifold learning.
- Geometric latent variable models and geometric generative models.
- Optimisation on smooth manifolds.
- Geometric robot control, geometry in mechanics and control.

Examination

- LAB1 - Laboratory Work, 3.0 credits, grading scale: A, B, C, D, E, FX, F
- PRO1 - Project Work, 2.5 credits, grading scale: A, B, C, D, E, FX, F
- TEN1 - Written Exam, 2.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability. The examiner may

apply another examination format when re-examining individual students. If the course is discontinued, students may request to be examined during the following two academic years.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.