high tech institute

mechatronics academy brainport

Advanced feedforward and learning control

Price:	€ 2,295 excl. VAT
Duration:	3 consecutive days
Contact:	training@hightechinstitute.nl, +31 85 401 3600
Score:	8.9 ★★★★☆

Intro

Do you also have a system that has the same error for each task? This course enables you to improve the performance of your system by advanced feedforward and learning control. In recent years, classical feedback controllers and feedforward controllers have been further developed towards advanced feedforward. These developments include iterative learning control, which applies to industrial systems, including pick-and-place machines or batch processes, that perform the same task over and over again. When exactly the same task is performed, disturbances act on the system identically over the tasks.

Think, for instance, about a disturbance torque profile, from unbalance in an axis, or from unknown friction effects. The key idea is that iterative learning control can completely compensate for these disturbances, leading to a typical order of magnitude reduction of servo errors.

Iterative learning control is able to achieve exceptional performance for exactly repeating tasks. However, iterative learning control cannot deal with varying tasks. Even a small variation can lead to disastrous performance deterioration. Many industrial systems perform such very similar yet slightly different tasks, necessitating new concepts for advanced feedforward control, including high-order feedforward (snap, jerk, etc.), input shaping, automated tuning, etc. These new concepts have been developed in recent years, whereas most of these 'iterative learning control' (ILC) techniques have been developed in the past two decades and many successful industrial applications have been reported.

This new and extended course starts by recapitulating classical feedforward, and covers an in-depth treatment of iterative learning control, repetitive control, and new advanced feedforward approaches. The course covers:

- theory, e.g., understanding the convergence of learning control from classical feedback;
- design, learning how to design advanced feedforward and learning from typical motion control design approaches (loop-shaping);
- algorithms, full coverage of tailor-made Matlab-algorithms (with possibility to take these home).

Certified by

ecp2

Certification

This course is certified by the European society for precision engineering & nanotechnology (euspen) and the Dutch Society for Precision Engineering (DSPE) and leads to the ECP2-certificate.

Course leader

Prof. Maarten Steinbuch
Dr. Tom Oomen

Trainers

Prof. Maarten Steinbuch
Dr. Tom Oomen
Dr. Joost Bolder
Robin de Rozario MSc
Dr. Sjirk Koekebakker
Lennart Blanken

** Prices are subject to change. Price correction will be applied at the end of the year.*

Objective

After attending this course, participants are enabled to:

- apply basic feedforward for motion control;
- recognize which technique is applicable to the specific application at hand (e.g., iterative learning control, repetitive control, and new advanced feed-forward algorithms);
- analyze and design ILC controllers addressing both performance and robustness (convergence), both in frequency domain and lifted domain;
- implement and analyze repetitive controllers;
- implement and analyze basis functions in ILC;
- auto tuning of advanced feedforward controllers;
- apply input shapers and rational feedforward;
- design and implement model-free learning controllers;
- obtain hands-on experience on an industrial mechanical positioning system.

Intended for

This course is intended for engineers involved in control systems who want to gain more insight into the possibilities and implementations of advanced feedforward and learning control in an industrial setting.

It is recommended that participants already have a Bachelor or Master education in electrical engineering, mechanical engineering, mechatronics, physics, or equivalent practical experience and must have some basic understanding of servo control.

This course is particularly suitable for engineers having followed the course in 'Motion control tuning'.

Program

The following topics are treated:

- Overview application areas;
- Iterative learning control: basic principles, frequency domain approach, convergence and robustness analysis, and design;
- Repetitive control: basic principles, theory, design, and algorithms;
- Lifted iterative learning control: basic principles, analysis, optimal design;
- Basis functions in iterative learning control;
- Automated feedforward tuning;
- Input shaping and rational feedforward;
- Model-free learning controller design (IIC);
- Practical examples;
- Simulation and design of systems using Matlab and SIMULINK;
- Hands-on experience with real-time implementation using SIMULINK on HP printer setup.