

TRAINING BROCHURE

Passive damping for high tech systems training



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Passive damping for high tech systems

Price: € 2,365 excl. VAT *
Duration: 3 consecutive days
Contact: training@hightechinstitute.nl, +31 85 401 3600
Score: 8.6 ★★★★★☆

Intro

The application of passive damping is becoming a key knob for getting precision engineering applications to meet tighter specifications over time. In particular for high-tech systems, we see high-bandwidth control of systems that are classically designed for high reproducibility, i.e. based on masses and springs, becoming increasingly difficult. Despite the risk of hysteresis related virtual play, passive damping can highly simplify controller design and improve positioning performance.

This course will address the design, modelling and implementation of passive damping in high-tech systems. We will discuss the trade-offs between damping on the one hand, and stiffness and position uncertainty on the other. Various passive damping principles will be discussed, viz. material damping (viscous-, linear viscoelastic- and composite damping), tuned mass- and robust mass damping, and constrained- and free-layer damping. We will focus on different application areas, such as medical equipment, machine tools and semiconductor applications.

If on-site training is not feasible, we will transition to a live, interactive online (virtual) or hybrid format. If this transition is necessary, we will contact you in advance for your approval.

Objective

Participants will acquire a mix of theoretical background, do's and don'ts and practical insight. After the course, participants understand the potential of the different passive damping approaches and will be able to initiate, specify and guide the development or select the proper off-the-shelf solution.

Intended for

This course is intended for engineers (both designers and architects) involved in high precision motions systems who want to gain more insight into the possibilities and limitations for the applications of passive damping.

It is recommended that participants already have a Bachelor or Master degree in mechanical- or electrical engineering, mechatronics, physics, or an equivalent practical experience, and have some basic understanding of precision engineering. This course is particularly suitable for engineers having followed the course in 'Design Principles for Precision Engineering' and/or 'Dynamics and Modelling'.

Certified by



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. Hans Vermeulen](#)
[Dr. Adrian Rankers](#)

Trainers

[Dr. Kees Verbaan](#)
[Prof. Hans Vermeulen](#)
[Dr. Stan van der Meulen](#)

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

Keep me posted



Program

Day 1

Introduction passive damping

- Recap Design principles, Dynamic modelling, Motion control;
- Definition;
- Trade off Damping vs. stiffness and Damping vs. virtual play.

Examples in other application areas

- Aviation;
- Structural buildings;
- Machine tools.

Discussion of damping principles

- Material damping;
- TMD, RMD, CLD, FLD;
- Eddy-current damping;
- Friction damping.

Day 2

Material damping

- Structural material damping;
- Viscous fluid damping;
- LVE material damping.

Demo / Exercise

Tuned mass damping

- TMD tuning;
- Case: MRI scanner.

Constrained layer damping

- RKU modelling approach;
- Case: Flexures and frames.

Exercise

Day 3

Constrained layer damping for discontinuous surfaces

- Hybrid approach.

Robust mass damping

- Viscous damper design and testing;
- Case: Semiconductor wafer stage.

Integral modelling and optimisation

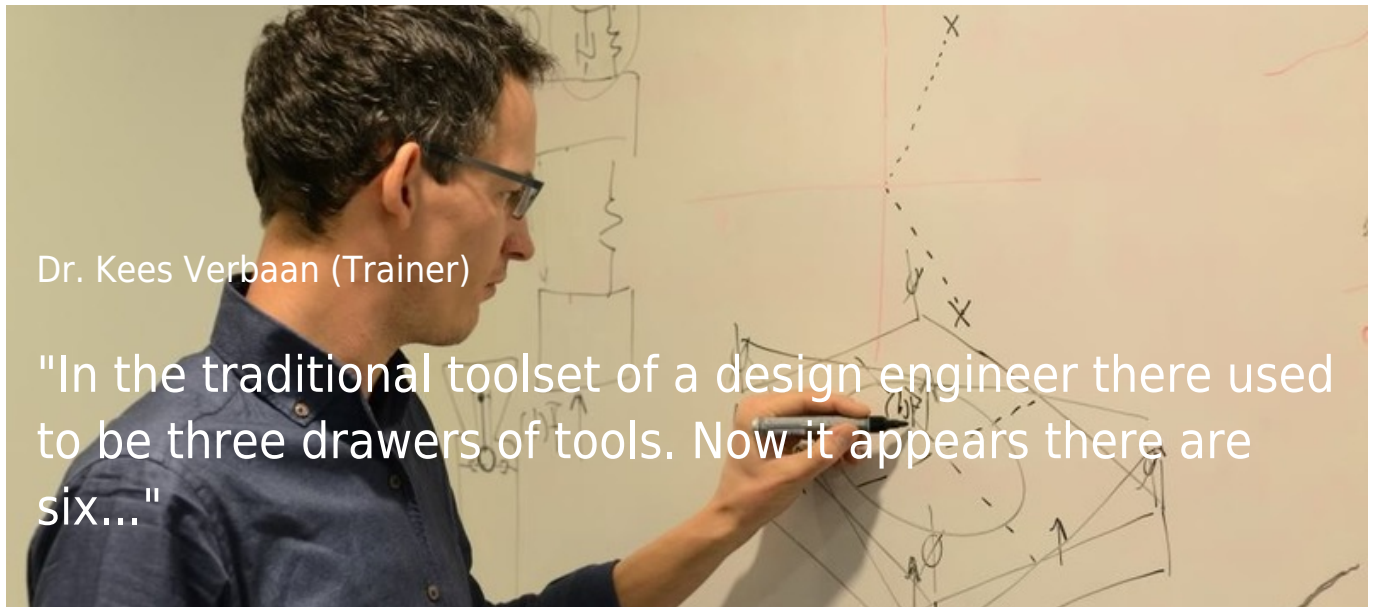
- Modeling approach;
- Optimisation algorithm;
- Case: Over-actuated wafer chuck.

Viscoelastic actuator damping

- Modeling approach;
- Case: Semiconductor wafer stage.

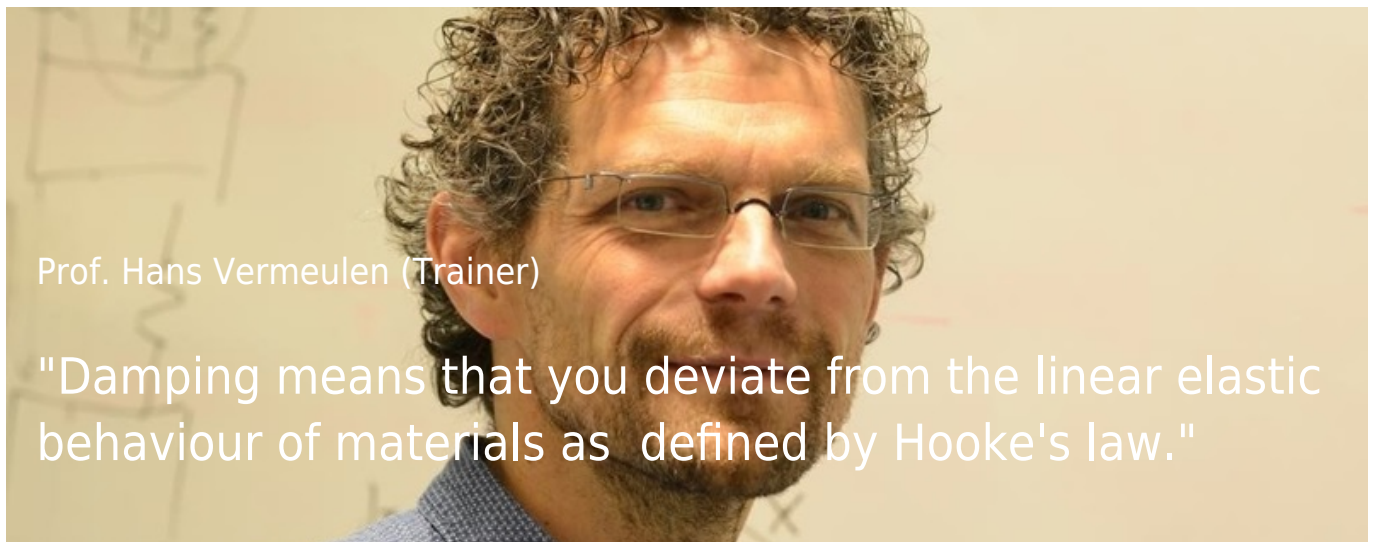
Wrap-up

Read the interview:



Dr. Kees Verbaan (Trainer)

"In the traditional toolset of a design engineer there used to be three drawers of tools. Now it appears there are six..."



Prof. Hans Vermeulen (Trainer)

"Damping means that you deviate from the linear elastic behaviour of materials as defined by Hooke's law."

Remarks from participants:

- "Most important things I have learned: Design -> first stiffness the damping how to design a damper made of rubber. Some detail aspects in the different design steps." > Aart ,Jan van der Voort
- "Very inspiring; I already have multiple ideas how to use passive damping in actual systems." > Gert van Ooik - Sioux CCM
- "The training taught me what I was expecting to learn in a good manner." > Lucas Monteiro Volpe , Brazilian Synchrotron Light Laboratory
- "Theory used from different points of view, helps to understand reality which is quite complex." > André Jeunink , ASML