

## STIMESI MEMS Training Course Program

# MEMS design and prototyping



Vestfold University College (VUC)  
Tønsberg (Oslo), Norway  
October 1-5, 2012

### Abstract

This five day training course tries to give a condensed but extensive overview of many aspects that are involved when entering the MEMS discipline. Starting with some definitions, characteristics and principles of MEMS and placing it in its historical context, the course addresses the chain from initial idea to prototype and eventual production. After an introductory tour into 'small world physics', technology and processing techniques, analog to the life cycle of typical MEMS product, the course focuses on MEMS design tools, methodologies, design flow, setup, FEM/FEA, co-simulation, Tape Out procedure and Design Rule Checking (DRC), packaging, testing, qualification and failure analysis

Real fabricated microsystems and personal experience cases further illustrate methodologies, capabilities and pitfalls. Exercises and hands-on sessions on MEMS design tools are interleaved with the presentations to illustrate and practice the course material.

This course is complementary to the other STIMESI courses which focus more in depth on a given technology and design tool.

### Target Groups

The course is primarily aimed at postgraduate and PhD students, PhDs, Postdocs and researchers from European universities and research institutes, as well as project or marketing managers with background in different fields who want to learn more about MEMS and all the aspects that are involved when starting MEMS activities. Researchers from industry and other organizations can also attend. No prior knowledge of MEMS design and processing is required.

### EURO-DOTS (European Doctoral Training Support in Micro/Nano-electronics)

This course fulfills all the criteria imposed by the FP7 EURO-DOTS program, and has been provisionally granted the EURO-DOTS label.

This means that PhD students can select this course if that fits directly with their area of interest as a complement to courses that they can take at their home university. [ECTS Credits](#) are awarded to individual students after completion of the course and the exam/evaluation organized at the completion of the course. Secondly, PhD students, fulfilling the requirements, can apply for a [scholarship](#) that covers course subscription fee and travel costs. Details on the FP7 EURO-DOTS program, these requirements and the application procedure can be found on [Students >> Rules](#).

>> [Download the evaluation and exam format for ECTS credits](#)



Note: The EURO-DOTS aspect is optional. The course is obviously also open to non-PhD students, academic staff, researchers and people from industry. For these attendees the EURO-DOTS rules do not apply and these attendees do not need to fulfill the exam/evaluation task. A course attendance certificate is sent to all attendees after the course.

### Objectives

- Create a general overview of many aspects that are involved when entering the MEMS (design) discipline.
- Explain what is involved when designing from the idea to production. Provide an overview of tools, tasks and flow.
- Introduce the key concepts of technology and processing techniques, provide awareness of small scale physics.
- Classify MEMS simulation approaches.
- Explain design rules to enable attendees to design with confidence.
- Give participants a taste of typical design tools.
- Support participants to start or improve design strategy.
- Create awareness about the impact of packaging and board assembly on the reliability of MEMS

## Topics

### Day 1

Day one starts with some definitions, characteristics and principles of MEMS and places MEMS in its historical context. Previously fabricated microsystems which are representative of the capabilities of MEMS give a good taste of the power of microsystems. Next, key concepts of technology and processing techniques are discussed. A practical hands-on session using a design layout tool (L-Edit) and a process modeler-emulator (Semulator3D) closes the afternoon

### Day 2

The second day of this training course starts with the design cycle 'from idea to product(ion)' using a gyroscope design as an example. Morning sessions cover the theoretic part. Afternoon sessions offer time to exercise by way of guided hands-on sessions.

The first part covers the 'creative' aspects of the development: MEMS sensing principles, application of the former to the concept of the gyroscope, technology selection, design space exploration, ...

### Day 3

The third day of this training course continues on the design cycle 'from idea to product(ion)' and broadens the focus from the MEMS part to the final application. Aspects like reliability, packaging and board level assembly technology are briefly discussed. Prototype testing (characterization, qualification and failure analysis) often undervalued, yet essential for MEMS, are discussed and the FMEA methodology is introduced. During Hands-on sessions in the afternoon, attendees will learn MEMS modeling by way of Behavioral Models (BM) using Coventor MEMS+ tool.

### Day 4

Finite Element Modeling (FEM) and Analysis (FEA) which is the workhorse for multiphysics simulation and verification is covered. Other techniques like Reduced Order Modeling (ROM) and Behavioral Models (BM) and their usefulness are explained in the context of co-simulation of MEMS+IC. Hands-on sessions allow attendees explore these two approaches of MEMS simulation: FEM/FEA and schematic modeling of MEMS using BM's using CoventorWare and MEMS+ respectively.

### Day 5

The fifth day of the course addresses the next steps on the roadmap: final layout verification (DRC) and Tape Out. The importance of well documented process handbook and the translation into a Design Rule Deck is presented. The use of these tools beyond design rule checking is demonstrated and hands-on sessions allow attendees to experiment with a DRC tool (L-Edit).

## What is STIMESi?

The goal of the STIMESi Stimulation Action is to stimulate European universities and research institutes to adopt MEMS technologies. The more experienced universities already active in MEMS design / technology will be assisted to increase their MEMS research activities and to design and fabricate more MEMS circuits and components. Additionally other universities not currently active in this area will be given guidance to help them bootstrap their MEMS teaching and research activities.

## What is EURO-DOTS?

EURO-DOTS is aimed primarily at improving the offering and the quality of training proposed to European PhD students. It helps fulfilling the requirements for ECTS credits imposed to PhD students by major European universities for obtaining the Doctoral (PhD) degree in Engineering. A coherent set of advanced courses in micro/nano-electronics, accredited by major European universities in the framework of their Doctoral Program, are made easily accessible to European PhD students, offering the opportunity to collect ECTS credits throughout Europe. The global objective of EURO-DOTS is to create a delocalized (virtual) platform to serve the Doctoral Schools in Europe in micro/nano-electronics and microsystems. The courses respect specific organization criteria (short, intensive one-week course modules with optional exam) that make them flexible, accessible and attractive as well for continuous education of engineers from industry. Scholarships are available to selected PhD students.



## Who should attend?

All universities and research institutes that want to begin or strengthen their teaching and/or research activities in MEMS technologies. Also companies having interest in using MEMS in future products are invited to attend.

## Location

The course will be held at the Vestfold University College (VUC), Borre.

The Vestfold University College is located in modern buildings in the beautiful surroundings at Vestfold County on the east coast of Norway – approximately one hour from Norway's capital, Oslo. The campus is located in Horten (Borre), one of Vestfold's seven towns. Vestfold is easily reached by air, ferry and train. There is a popular airport nearby with affordable flights to nearly all major cities in Europe.

Vestfold University College is a Norwegian state institution of higher education. It was established August 1, 1994 by the merger of three university colleges, and has approximately 4500 students and 500 staff. The university college has four faculties: Humanities and Education, Health Sciences, Economics and Social science, and Technology and Maritime Sciences. Vestfold University College participates actively in the major exchange programs within the EU's Lifelong Learning program - Erasmus.

Research and development activities are carried out in close cooperation with the high-tech industry in the region, as well as other leading national and international institutions. An increasing number of research and development activities are supported by EU programs, the Norwegian Research Council and directly by industry.

IMST is the Department of Micro and Nano Systems Technology at Vestfold University College. IMST represents the country's largest academic environment within microsystems technology and is one of the largest research environments within micro and nanosystems. IMST has built up expertise at international level within the specialized area of building methods for micro and nanosystems. Some of the areas of current research are silicon microsystems, packaging, interconnection and biological microelectromechanical systems (BioMEMS) spanning implantable microdevices. The research facilities offer a class 1000 clean room with a full lithography line, electronic and mechanical workshop, and laboratories for cell culture and biochemistry. The research is funded by grants from the Research Council of Norway, the European Union and industrial contract research.

Vestfold University College is the coordinator of the governmental sponsored cluster program Norwegian Centre of Expertise, Micro and Nanotechnology, working in close collaboration with regional industry.

The STIME SI Course will take place at

### Address:

Vestfold University College  
Raveien 197  
3184 Borre  
Norway

### Useful links:

Website of VUC  
How to come to VUC  
Google Maps:  
About Vestfold  
About Oslo  
Sandefjord Airport  
Oslo Gardermoen Airport

[www.hive.no](http://www.hive.no)  
[www.hive.no/how-to-get-here/category1707.html](http://www.hive.no/how-to-get-here/category1707.html)  
<http://goo.gl/maps/FhgQ>  
[www.visitvestfold.com](http://www.visitvestfold.com)  
[www.visitoslo.com](http://www.visitoslo.com)  
[www.torp.no](http://www.torp.no)  
[www.osl.no](http://www.osl.no)



**Start /end date: October 1-5, 2012**

## Fees

Attendance is kept low in order to lower the barrier for members of universities and research institutes. However, a fee will be required to cover the cost of the local infrastructure, catering, ...

- Attendance fee: 250 €
- Fees exclude VAT which will be invoiced subject to national regulations.
- STIMESI staff will send you information on how you can make the payment.
- Places on courses will not be confirmed until payment is completed.  
*DO NOT make any travel plans until your place is confirmed.*
- Fee includes all lectures, course materials, lunches and refreshment breaks and the Social Event dinner. Accommodation, transport and other meals are not included in the course fee.
- **Cancellation charges:**
  - Cancellation 14 or more days prior to the start of the course 100% of your fee will be refunded or credited
  - Cancellation between 7 and 14 days before the start of the course 50% of your fee will be refunded or credited
  - Cancellation within 7 days of the start of the course (or for those who do not attend) no fees will be refunded or credited
- In case the course is oversubscribed, access may be limited to one participant per institute and will be on a first-come basis.

## Accommodation

Participants need to make their own accommodation and travel arrangements.

The following hotels are a good starting point and are close to VUC.

Click [here](#) to find out the exact location of these hotels on Google maps.

Hotel name	Phone Fax	Email website	Location
<b>Best Western Horten Hotell</b> Jernbanegaten 1, 3187 Horten	+47 33 08 33 80 +47 33 08 33 81	service@hortenhotell.no www.bestwestern.no/horten	<a href="#">Click here</a>
<b>Thon Hotel Åsgårdstrand</b> Havnegata 6, 3179 Åsgårdstrand	+47 33 02 07 40 +47 33 08 10 77	asgardstrand@thonhotels.no www.thonhotels.com/hotels/countrys/norway/asgardstrand/thon-hotel-asgardstrand	<a href="#">Click here</a>
<b>Horten Naeringspark Hotell</b> Borreveien 44/46, 3186 Horten	+47 33 31 06 00	booking@borre.no www.hortenvandrerhjem.no	<a href="#">Click here</a>

For more hotels or touristic info in Vestfold, please visit the site:

[www.visitvestfold.com/en/accommodation](http://www.visitvestfold.com/en/accommodation)

## Registration

Registration can be done using the STIMESI Course Booking System, which is managed and maintained by STFC Rutherford Appleton Laboratory, UK.

The following link brings you there: <http://www.stimesi.stfc.ac.uk>

Browse to the [STIMESI Course Booking System](#), select the course of your choice and use the “Book This Course” link

## Notes:

This course is limited to **24** participants to ensure a high quality of training. Please reserve your place early.

A joining pack will be sent to registrants containing details of the course location, schedule and suggested local accommodation.

All necessary course material will be provided. To get complementary course materials, such as the SiGeMEMS Design Handbooks, the institutes or companies sending attendants to this course are requested to sign the required Design Kit License Agreement (DKLA) from the [EUROPRACTICE-IC service](#). Instructions on how to get the access to the Design Handbooks and the DKLA will be sent to the registered attendee prior to the course.

The STIMESI Course Booking System is managed and maintained by STFC Rutherford Appleton Laboratory. All enquires should be emailed to: [stimesi@stfc.ac.uk](mailto:stimesi@stfc.ac.uk)

## More information

For more information, please visit the following links:

[www.stimesi.org](http://www.stimesi.org)

[www.stimesi.stfc.ac.uk](http://www.stimesi.stfc.ac.uk)

[www.euopractice.com](http://www.euopractice.com)