**What is SMMiL-E / UTC School?**

SMMiL-E / UTC School aims at an introductory educational program for students new to BioMEMS. Sessions introduce each step from the initial device design to applications. A day at Centre Oscar Lambret, the regional reference hospital specialized in cancer, allows observing some cancer therapies to build a link between technology and translational medicine. Students, from Japan and France, have the opportunity to spend time with high-level researchers during lectures, experiments, and hands-on sessions. In addition to the BioMEMS-related classes, students also work on projects both in Lille and Compiègne. Major concepts related to BioMEMS will, first be covered at SMMiL-E. Then, a deeper view of organ-on-a-chip systems will be featured at UTC as proposed by the international chair with UTokyo "DOT- Disruptive Organoid Technology".

**Students learn...**

**Fundamentals of microfabrication**

- Design & simulation (CAD, COMSOL)
- Microfabrication (Metal patterning, Mold for PDMS microfluidics)
- Rapid prototyping (3D printing, CNC, 2PP)

**Biological techniques and analysis**

- Cellular bio. fundamentals (Cell culturing)
- Mol. biology fundamentals (Western blotting, PCR)
- Imaging techniques: Electron & optical microscopy (BF, Fl, PC, DIC and confocal)

**Device integration and applications**

- Microfluidics (Laminar flow, flow charact.)
- Organ-on-a-chip (3D cell culture)
- Cell characterization (Imp. spec. & mech. charact.)
- Predictive Toxicology

**Link to translational medicine**

- Cancer therapies (Surgery, chemotherapy and radiation therapy)

**Group projects**

- BioMEMS projects (Handled by students)
Class content

SMMiL-E / UTC School consists of three types of classes. Each day starts with a lecture on the topic of the day. The lectures are supported with observation sessions where students can observe researchers performing experiments on given topics. The last type of class permits students to perform hands-on experiments as a part of BioMEMS projects.

I. Device & setup development

1. Design & simulation tools
   a) Drawing device elements (e.g. channels & electrodes)
   b) Basic simulations (e.g. flow & electrical field)

2. Microfabrication
   a) Fundamental techniques (e.g. lithography, deposit., etching)
   b) Rapid prototyping tools
      Nanoscribe, 3D printer, CNC

3. Observation & characterization
   a) Microscopy (optical & electron)
   b) Profilometer & probe station

4. Operating BioMEMS systems

II. Fundamental techniques

1. Cellular biology
   a) Cell culturing
   b) Flow cytometry
   c) Plasmid transfection
   d) Electroporation

2. Cell physiology
   a) Patch-clamp
   b) Calcium imaging

3. Molecular biology
   a) PCR
   b) Nucleic acid extraction
   c) Gene expression
   d) rtPCR
   e) Western blotting

4. Microfluidic systems
   a) PDMS molding
   b) Laminar flow microfluidics

5. Cancer therapies
   a) Imaging
   b) Pathology
   c) Chemotherapy
   d) Radiotherapy

III. Applied systems

1. Vessel-on-a-chip
   - Mimicking blood vessels

2. Biophysical cell charact.
   a) Single cell analysis
   b) Handling BioMEMS systems

IV. Special feature: Organ-on-a-chip systems

1. Application
   a) Toxicology studies
   b) Regulatory issues
   c) Predictive toxicology

2. Device overview
   a) Flow characterization
   b) Cell seeding
   c) Perfusion devices

Facilities

Microfabrication and imaging

- Lithography
- Deposition
- Etching
- Characterization
- Rapid prototyping
- FE-SEM
- Airyscan confocal microscopy
- Inverted and upright microscopes

Molecular and cellular biology

- Cell culturing
- Bioprinter
- Culture under perfusion
- Abs/Lum/Fluo/Alphascr. plate reader
- Classic & real-time PCR
- DNA/RNA & protein quantification & analyses
- Nucleic acids & protein gel imaging systems

Tissue Engineering

- Organoid formation
- Cell encapsulation
- Bioreactors
- Micro/nano indentation
- Dynamic cell culture
- Perfusion systems
- Time lapse microscopy
- Immunocytochemistry

Microfluidics

- High speed camera
- Micro Particle Imaging
- Velocimetry
- Pressure controllers
- Flow and image analysis
- Viscosimetry
- Fluid Structure Interactions Simulations
## Timetable

### 2023

<table>
<thead>
<tr>
<th>Time</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
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<th>Fri</th>
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<tbody>
<tr>
<td>8:30</td>
<td>Opening remarks</td>
<td>Designing microstructures</td>
<td>Fundamentals of Cellular Biology</td>
<td>Single cell biophysical characterization</td>
<td>Cancer Therapy</td>
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<tr>
<td></td>
<td>Introduction to BioMEMS</td>
<td>M. Kumemura, M.C. Tarhan</td>
<td>F. Soncin</td>
<td>D. Collard</td>
<td>E. Lartigau, S. Meignan</td>
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<td>10:15</td>
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<td>12:30</td>
<td>Lunch</td>
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<tr>
<td>14:30</td>
<td>Rapid prototyping</td>
<td>Project work</td>
<td>Project work</td>
<td>Project work</td>
<td>Social gathering and local activities</td>
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<td>F.A. Shaik</td>
<td>Project work</td>
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<td>17:00</td>
<td>Group meeting for project management</td>
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### Professors

<table>
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<tr>
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<tbody>
<tr>
<td>L. Ceugnart (COL) Clinical Medicine</td>
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<td>M. P. Chauvet (COL) Clinical Medicine</td>
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<td>D. Collard (LIMMS) MEMS</td>
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<td>F. Feutry (COL) Clinical Medicine</td>
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<td>A. L. Gagez (COL) Clinical Medicine</td>
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<td>J.-C. Gerbedoen (LIMMS) Microfabrication</td>
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<td>K. Hannebicque (COL) Clinical Medicine</td>
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<td>M. Jafari (COL) Clinical Medicine</td>
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<td>S.H. Kim (IIS) Microfluidics</td>
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<td>M. Kumemura (Kyutech, IIS) Microfluidics</td>
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<td>C. Lagadec (CANTHER/INSERM) Cellular biol.</td>
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<td>E. Lartigau (COL) Clinical Medicine</td>
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<td>L. Lemonnier (Phycell/INSERM) Molecular electrophysio.</td>
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<td>G. Marliot (COL) Clinical Medicine</td>
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<td>S. Meignan (COL) Molecular biology</td>
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<td>Y. Matsunaga (IIS) Organ-on-chip</td>
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**Lecture**
- **20 / Feb Mon**: Applications of Molecular Electrophysiology by L. Lemonnier
- **21 / Feb Tue**: Lecture by Y. Matsunaga
- **22 / Feb Wed**: Organ-on-chip for toxicology studies by E. Leclerc
- **23 / Feb Thr**: Microfluidics and cell behavior by A. Le Goff
- **24 / Feb Fri**: Regulatory issues with organ-on-chips by Y. Sakai, M. Nishikawa, J-M. Prot

**Observation**
- **20 / Feb Mon**: Group presentation by L. Lemonnier
- **21 / Feb Tue**: Getting together

**Hands-on**
- **22 / Feb Wed**: Cell seeding in different biochips by D. Collard
- **23 / Feb Thr**: Flow and pressure characterization in microfluidic devices by R. Jellali

**Student Engagement**
- **20 / Feb Mon**: Mini project
- **21 / Feb Tue**: Get together party

**Lille**
- X. Mirabel (COL) Clinical Medicine
- N. Penel (COL) Clinical Medicine
- Y. M. Robin (COL) Clinical Medicine
- F. A. Shaik (LIMMS) Design & Sim.

**Compiègne**
- M. C. Tarhan (IEMN, Junia) MEMS
- A. Trezeibre (IEMN) Microfluidics
- L. Vanlemmens (COL) Clinical Medicine
- E. Leclerc (LIMMS, UTC) Organ-on-chip, omics
- C. Legallais (UTC) Tissue engineering

**Professors**
- M. Nishikawa (UTokyo) Bio simulation
- A. Le Goff (UTC) Physics of fluids
- E. Leclerc (LIMMS, UTC) Organ-on-chip, omics
- Y. Sakai (LIMMS, UTokyo) Biochemical syst. engineering

**Days**
- Mon
- Tue
- Wed
- Thr
- Fri
- Sat
Where is SMMiL-E located?

ONCOLille building

Possible Accommodation at the Lille center

SMMiL-E facilities @ONCOLille

Centre Oscar Lambret

Lille is located in the center of European cities & countries accessible by train.

Where is UTC located?

UTC Research Center

Compiègne is a historical city, 45 min away from Paris and CDG airport.