



2024

# 4<sup>th</sup> International School on BioMEMS

## Fundamentals of microfabrication

- Design and simulation
- Microfabrication
- Characterization

## Biological techniques & analysis

- Microscopy
- Cellular biology
- Molecular biology

## Device integration & applications

- Microfluidics
- Organ-on-a-chip
- Single cell characterization

## Link to translational medicine

- Clinical cancer management
- Techniques of tissue sampling
- Pathological sample processing

## Additionally...

- Group projects
- Social events

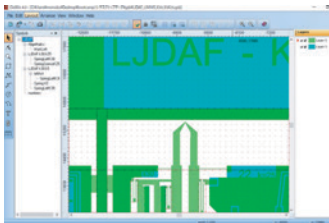


# What is SMMiL-E / UTC School?

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 projects 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...

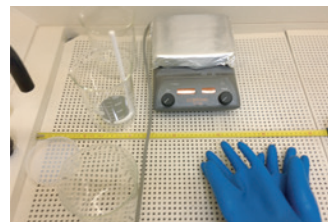
### Fundamentals of microfabrication



Design & simulation  
(CAD, COMSOL)

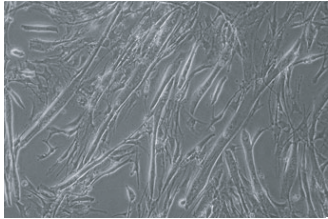


Microfabrication  
(Metal patterning, Mold for PDMS microfluidics)



Rapid prototyping  
(3D printing, CNC, 2PP)

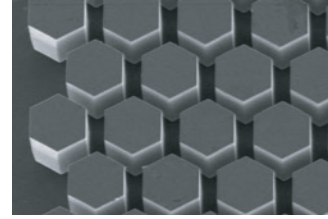
### Biological techniques and analysis



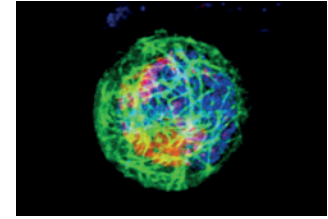
Cellular bio. fundamentals  
(Cell culturing)



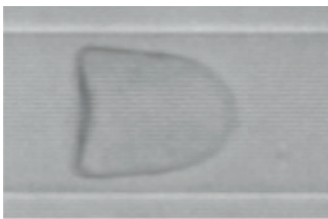
Mol. biology fundamentals  
(Western blotting, PCR)



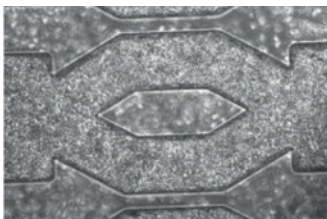
Imaging techniques:  
Electron & optical microscopy (BF, FI, PC, DIC and confocal)



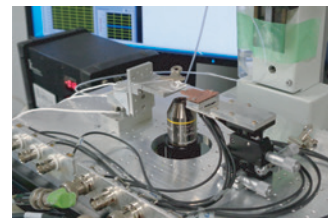
### Device integration and applications



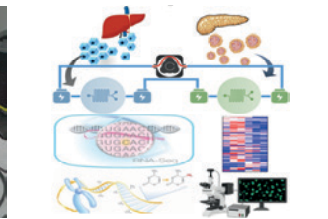
Microfluidics  
(Laminar flow, flow charact.)



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)



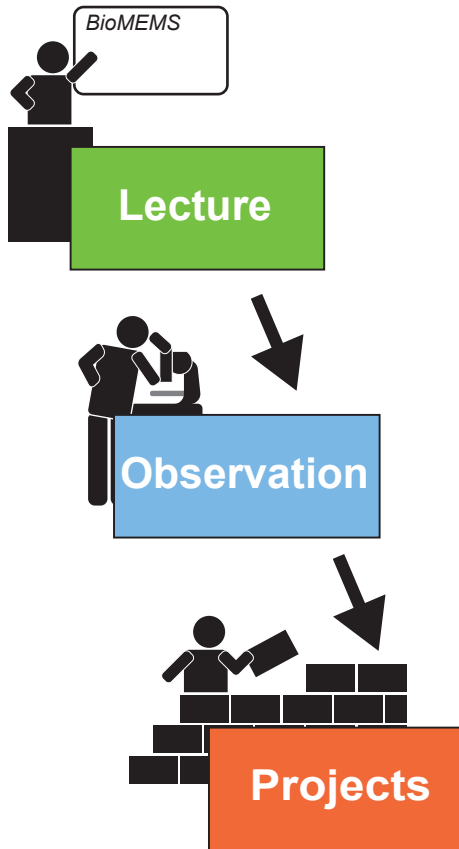
### Group projects



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 handle sample projects as a part of BioMEMS projects.



## I. Device & setup development

1. Microfabrication
  - a) *Fundamental techniques*  
(e.g. lithography, deposit., etching)
  - b) *Rapid prototyping tools*  
Nanoscribe, 3D printer, CNC
2. Observation & characterization
  - a) *Microscopy (optical & electron)*
  - b) *Profilometer & probe station*
3. Operating BioMEMS systems

## II. Fundamental techniques

1. Cellular biology
  - a) *Cell culturing*
  - b) *Flow cytometry*
  - c) *Plasmid transfection*
2. Molecular biology
  - a) *PCR*
  - b) *Nucleic acid extraction*
  - c) *Gene expression*
  - d) *rtPCR*
  - e) *Western blotting*
3. Microfluidic systems
  - a) *PDMS molding*
  - b) *Laminar flow microfluidics*
4. 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



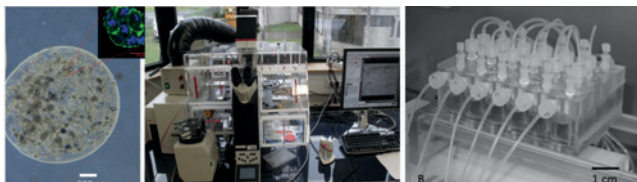
- Lithography
- Deposition
- Etching
- Characterization
- Rapid prototyping
- FE-SEM
- Airyscan confocal microscopy
- Inverted and upright microscopes

## Molecular and cellular biology



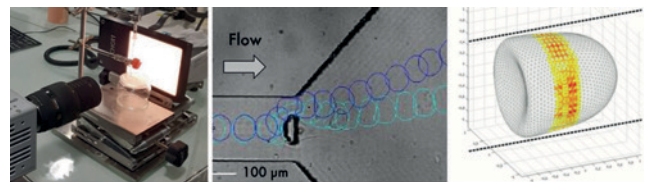
- Cell culturing
- Bioprinter
- Culture under perfusion
- Abs/Lum/Fluo/Alphascr. plate reader
- Classic & real-time PCR
- DNA/RNA & protein quantification & analyses
- Nucleic acids & protein gel imaging systems

## 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

2024

	06 / Feb Tue	07 / Feb Wed	08 / Feb Thr	09 / Feb Fri	10 / Feb Sat
8:30		Organ-on-chip for toxicology studies E. Leclerc	Mathematical model, system biology & predictive toxicology M. Nishikawa	Regulatory issues with organ-on-chips J-M. Prot C. Legallais	Networking event
10:15					
10:30		Organ-on-chip for toxicology studies Y. Sakai	Fundamentals of Microfluidic Systems S.H. Kim	Mini project	
12:30					
13:30	Welcome in Compiègne	Lunch	Lunch	Lunch	
15:15					
15:30	Biochip microfabrication and Mini project R. Jellali	Cell seeding in different biochips and Mini project R. Jellali	Flow and pressure characterization in microfluidic devices and Mini project A. Le Goff	Mini project Project presentation	
17:30			Compiègne tour	Get together party	

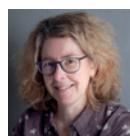
## Professors

### Compiègne

### Lille



R. Jellali  
(UTC)  
Biomaterials



C. Legallais  
(UTC)  
Tissue engineering



L. Ceugnart  
(COL)  
Clinical Medicine



A. L. Gagez  
(COL)  
Clinical Medicine



A. Le Goff  
(UTC)  
Physics of fluids



M. Nishikawa  
(UTokyo)  
Bio simulation



M. P. Chauvet  
(COL)  
Clinical Medicine



J.-C. Gerbedoen  
(LIMMS)  
Microfabrication



S.H. Kim  
(IIS)  
Microfluidics



J. M. Prot  
(UTC)  
Regulat. affairs,  
Biomedical eng.



D. Collard  
(LIMMS)  
MEMS



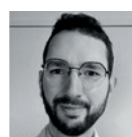
K. Hannebicque  
(COL)  
Clinical Medicine



E. Leclerc  
(LIMMS, UTC)  
Organ-on-chip,  
omics



Y. Sakai  
(LIMMS, UTokyo)  
Biochemical syst.  
engineering



F. Feutry  
(COL)  
Clinical Medicine



M. Jafari  
(COL)  
Clinical Medicine

Lecture

Observation

Projects

Student Engagement

2024

12 / Feb Mon	13 / Feb Tue	14 / Feb Wed	15 / Feb Thr	16 / Feb Fri	
Opening remarks Introduction to BioMEMS  D. Collard S.H. Kim M.C. Tarhan	Fundamentals of Cellular Biology  F. Soncin	Cancer Therapy  E. Lartigau S. Meignan	Fundamentals of Micromachining  M. Kumemura M. C. Tarhan	Single cell biophysical characterization  D. Collard	8:30
					10:15
Fundamentals of Microfluidic Systems  S.H. Kim	Fundamentals of Molecular Biology  F. Soncin	Cancer Therapies: Biopath, Radiother. Imaging, Chemother. Clinical research Y. Robin, L. Ceugnart, X. Mirabel, F. Feutry, N. Penel, M.P. Chauvet	Organ-on-a-chip Systems  A. Treizebre	Organoid platform & Cleanroom visit	10:30
Lunch	Lunch	Lunch	Lunch	Lunch	12:30
Group meeting for project management	Fabrication tech. J.C. Gerbedoen  Rapid prototyping F.A. Shaik	Cancer Therapies: Surgery, Translat. research  L. Vanlemmens A.L. Gagez, M. Jafari	Confocal microsc. C. Lagadec  Elect/optic microsc. M.C. Tarhan	Cell culturing/PCR F. Soncin  Western blotting S. Meignan	13:30
Project work	Project work	Eurasanté Visit	Project work	Group presentation	14:30
	Group meeting		Group meeting	Closing remarks Shinohara/Tarhan	16:30
					17:30

Lille

Professors



M. Kumemura  
(Kyutech, IIS)  
Microfluidics



G. Marliot  
(COL)  
Clinical  
Medicine



N. Penel  
(COL)  
Clinical  
Medicine



F. Soncin  
(LIMMS)  
Molecular biol.  
Cellular biol.



C. Lagadec  
(CANTHER/  
INSERM)  
Cellular biol.



Y. Matsunaga  
(IIS)  
Organ-on-chip



Y. M. Robin  
(COL)  
Clinical  
Medicine



M. C. Tarhan  
(IEMN, Junia)  
MEMS



E. Lartigau  
(COL)  
Clinical  
Medicine



S. Meignan  
(COL)  
Molecular  
biology



F. A. Shaik  
(LIMMS)  
Design & sim.



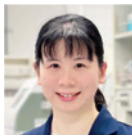
A. Treizebre  
(IEMN)  
Microfluidics



L. Lemonnier  
(Phycell/INSERM)  
Molecular  
electrophysiol.



X. Mirabel  
(COL)  
Clinical  
Medicine



M. Shinohara  
(IIS)  
Organ-on-chip  
Biology



L. Vanlemmens  
(COL)  
Clinical  
Medicine

# Where is SMMiL-E located?

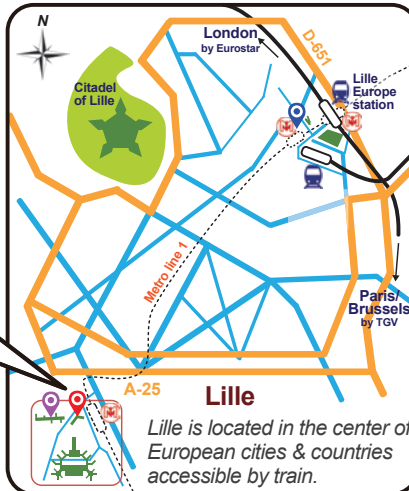
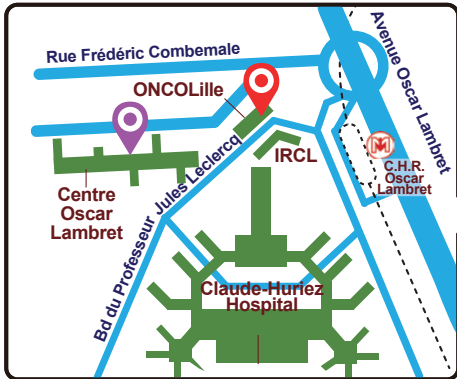
ONCOLille building



Possible Accomodation at the Lille center



- SMMiL-E facilities @ONCOLille
- Centre Oscar Lambret



# Where is UTC located?



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



UTC Research Center

