

# Additive manufacturing in healthcare: from 3d printing to bioprinting

Lake Como School of Advanced Studies - 5-9 June 2023

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## Home

Over the last years, additive manufacturing (AM) has been used in many different fields and, among these, it has opened up new perspectives in medical and biomedical ones. Indeed, on one side, traditional 3D printing technologies allow to create patient-specific prostheses and to reproduce complex anatomical structures employed as support for surgical planning and training; on the other side, 3D bioprinting techniques, characterized by biological components and biomaterials, permit to overcome conventional 2D in vitro models and to better mimic organs in terms of their physiology and disease mechanisms and to potentially provide drug screening platforms for pharmaceutical companies and functional piece of tissues to be implanted within the human body.

This school aims to give an overview of all these aspects. After an introduction regarding state-of-the-art AM technologies, lectures will be organized according to the anatomical district of interest. In particular, organs like the pancreas, liver, brain, heart, bone, muscles will be taken into consideration; moreover, contents related to blood disorders and organ revascularization will be included. First, each of these will be described from an anatomical and physiological point of view, and, secondly, 3d printing and bioprinting applications will be treated separately by experts of the sector, who will show practical examples taken from hospitals and research reality.

Although it is not planned a hands-on section, the school will promote the discussion of practical aspects about the use of 3d (bio)printers and related to its working principles. To this aim, part of the school will devoted to the set-up and development of projects by the students with the supervision of the lecturers. Topics regarding implications of 3d printing and modelling in the field of biomechanics will be treated during the school. Finally, the students can show and discuss their research activities by dedicated poster sessions and pitches; in particular, awards will be assigned at the end of the school for the best poster and best project.



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## Organizing Committee

- Michele Conti (University of Pavia)
- Stefania Marconi (University of Pavia)
- Simona Celi (Fondazione Monasterio Massa)
- Carmelo De Maria (University of Pisa)
- Cristina Scielzo (IRCCS San Raffaele Hospital)
- Laura Russo (University of Milano-Bicocca)



**Simona Celi** is a senior scientist at Fondazione Toscana G. Monasterio. She is co-founder of the BioCardioLab where she is currently the group leader of the research lab. Main research topics are the correlation between in-vivo and ex-vivo data, development of in-silico approach through advanced image processing, experimental activities and finite element simulation with uncertainties quantification and sensitivities analysis.



**Michele Conti** is Associate Professor of Industrial Bioengineering at the [Department of Civil Engineering and Architecture](#) of the University of Pavia. His research interests are in the field of cardiovascular biomechanics, numerical and experimental analysis of endovascular devices, life support systems, and, in the last years, in novel technologies in biomedical field including 3D (bio)printing.



**Carmelo De Maria** is Assistant Professor of Bioengineering at the Department of Ingegneria dell'Informazione, University of Pisa, and affiliated with the Research Center "E. Piaggio", and co-founder and president of the [FabLab Pisa](#). His research interests are in the field of additive manufacturing/rapid prototyping technologies, with a particular focus in Biofabrication.



**Stefania Marconi** is Assistant Professor at the [Department of Civil Engineering and Architecture](#) of the University of Pavia, Italy. With a strong interest on additive manufacturing technologies and their application into biomedical sphere, she is the coordinator of [3D4Med](#), engaged in the production of patient-specific anatomical models for surgical planning and training, supports and devices for clinical use, and co-supervisors of [Protolab](#), laboratory devoted to research on additive manufacturing technologies and materials.



**Laura Russo** is Associate Professor at University of Milano-Bicocca and Adjunct Lecturer at National University of Ireland (Galway) and Visiting Researcher at Cúram (National University of Ireland, Galway). Her research interests are focused on glycochemistry and glycoscience, biomaterials for tissue engineering and 3D advanced in vitro models, 3D bioprinting and biopolymers design and, finally, functionalization, modification and characterization of medical devices.



**Cristina Scielzo** is Group Leader at IRCCS Ospedale San Raffaele at the division of Experimental Oncology, Unit Lymphoid Malignancies. Her research interests are on the interplay between leukemic cells and the microenvironment, molecular characterization of chronic lymphocytic leukemia (CLL) cells, properties of the leukemic cells cytoskeleton and its role in regulating cells interactions with the microenvironment, and development of new advanced 3D in vitro co-culture systems by prototyping a bench-top 3D bio-printer.

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## Invited Speakers



**Paolo Netti** is the coordinator of the Center for Advanced Biomaterials for Health Care IIT@CRIB and a Full Professor of Material Science at the University of Naples Federico II. His research interest mainly focuses on the elucidating the complex interplay between materials properties and biological entities such as cells and biomolecules. His activities span from the basic understanding of the cell's regulatory events occurring at cell-materials interface to the technological development of novel class of biomaterials able to elicit and direct specific cell fate by encoding multiple arrays of biological active moieties.



**Francesco Pasqualini** is Associate Professor of Industrial Bioengineering at the Department of Civil Engineering and Architecture of the University of Pavia, holding an ERC starting grant since 2019. His research interests are in the field of in-silico and in-vitro models of muscle tissue engineering, quality control standards for stem cell derived myocytes and a variety of disease modeling applications.



**Itedale Namro Redwan** is Chief Scientific Officer, Director of Bioink and Tissue Engineering R&D at Cellink (Sweden), one of the main companies in the field of 3d bioprinting. She has expertise in Medicinal/Organic Chemistry, Chemical Biology, Stem Cell Biology, Biomaterials, Bioinks and Bioprinting.



**Anna Worsley** is Director of Innovation at FabRx (London, UK), a specialist biotech start-up, focused on developing 3D printing technology for personalised pharmaceuticals and medical devices. Anna has interests in 3D printing, drug delivery, regenerative medicine, sustainability, materials engineering and manufacture, business, scientific communications and science policy.



**Maxime Annereau** is a full-time hospital pharmacist at Gustave Roussy. He has been working on international projects, with the implementation of a chemotherapy preparation unit in Astana Kazakhstan. Since 2016 he has worked in the chemotherapy preparation unit and is in charge of the preparations and control sector. In parallel he works on the development of new galenic form of anticancer drugs in collaboration with industrial partners.



**Giuseppina Sandri** is Associate Professor of pharmaceutical technology (Department of Drug Sciences, University of Pavia). Her research activity focuses on tissue engineering and nanomedicine and she is mainly involved in the design and the development of scaffolds based on biomaterials, especially polysaccharides, as dermal substitutes. Furthermore, she is working on the design and the development of innovative platforms to deliver hemoderivatives in tissue engineering.



**Julian Jones**. Professor of Biomaterials, Department of Materials, Imperial College of London, United Kingdom.

**Expertise:** porous scaffolds for regenerative medicine, porous materials for minimally invasive diagnosis, tough sol-gel hybrids, therapeutic nanoparticles, processing of glasses, bioactive materials, sol-gel chemistry, protein adsorption to nanotextured materials, cell responses to biomaterials.



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## Program

### Program

Topic	Technology	In vitro modeling	Drug screening	3D for clinics	AI & 3D printing
	Day 1 - Mon 5 June	Day 2 - Tue 6 June	Day 3 - Wed 7 June	Day 4 - Thu 8 June	Day 5 - Fri 9 June
9:00-10:30		<b>J. Jones</b> - Bioprinting for bone modeling	<b>A. Worsley, M. Annereau, G. Sandri</b> - 3D Printing for drugs	<b>M. Conti</b> - 3D and vascular modeling	<b>C. De Maria, A. Bonatti</b> - Fundamentals of the AI use in Bioprinting
10:30-11:00	Welcome and registration	Coffee break	Coffee break	Coffee break	Coffee break
11:00-12:30	<b>Prof. Paolo Netti</b> - Opening lecture: 3D in tissue engineering	<b>L. Russo</b> - Biomaterials for bioprinting (focus on in-vitro gut modeling)	<b>Francesco Pasqualini</b> - Cardiac modeling/drug screening	<b>S. Celi</b> - 3D printing- and simulations- based modeling in cardio for treatment of adult and child patients	Project discussion and awards
12:30-14:00	Lunch (poster session)	Lunch (poster session)	Lunch (poster session)	Lunch (poster session)	Lunch & Farewell
14:00-15:30	<b>S. Marconi</b> - Technology for 3D printing for medicine	<b>C. Scielzo</b> - Bioprinting for in-vitro cancer modeling	<b>N. R. Itedale</b> - Bioprinting per drug discovery	<b>S. Marconi</b> - 3D4med.	
15:30-16:00	Coffee break	Coffee break	Coffee break	Coffee break	
16:00-17:30	<b>C. De Maria</b> - Technology in Bioprinting	Students' pitch/project assignment	Round table	Project development	
			Social event		

### Students' activities

**Motivation.** The school will promote the discussion of practical aspects of the use of 3D (bio)printers and underneath working principles. To this aim, part of the school will be devoted to the set-up and development of projects by the students with the supervision of the lecturers. Topics regarding the implications of 3D printing and modeling in tissue regeneration, in vitro tissue modeling, and biomechanics will be treated during the school. Finally, the students can show and discuss their research activities through dedicated poster sessions and pitches; in particular, at the end of the school, the best poster and best project will be awarded.

**Student's pitch/poster.** On Day 2 (Tue 6/6), there will be a pitch presentation, i.e., a short presentation in which the students can introduce themselves and their job/research activities, motivating their participation in the school. This information can be reported and extended in the posters that students can illustrate to teachers and colleagues during the poster session, designed as a moment of meeting between school participants. Poster size: 90x180cm.

**Project.** On Day 2 (Tue 6/6) the student class will be split into groups (max five students per group), trying to encourage inclusion in each group of different expertise based on the student's background. There are no practical hands-on sessions, and the activities will be focused on project planning (think about a grant proposal preparation), aimed at promoting the integration of various disciplines for the solution of clinical problems with the use of 3D (bio-)printing.

The interaction will favor the definition of the project with the lecturers.

A (bio)medical challenge to be addressed using 3D (bio)printing in each group.

The group will then have to formulate and propose a solution, which can be discussed with the lecturers throughout the whole school duration. In particular, on Day 4 (Thu. 8/6), a session will be devoted to further development of these group projects.

Finally, the developed project will be presented by each group on the last day of school (Fri. 11/06) in a 15-minute presentation. The presentation of the projects will then be evaluated for the assignment of the award.

