UNIVERSITÀ DI PISA

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

"Three-dimensional printing and bioprinting for applications in space flight"

Prof. Dr. Michael Gelinsky

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Short Abstract:

Since a couple of years, space flight is again developing strongly including several successful missions to Mars. The next big goal is to send humans again to Moon and establish the Deep Space Gateway, which is seen as the prerequisite for manned missions to Mars that are also already under investigation. Additive Manufacturing (AM) technologies do play an important role nowadays in fabrication of parts for spaceships and extraterrestrial vehicles and it is generally accepted that 3D printers will be used in space in near future for the production of spare parts. Other research is focussed on utilising autonomous AM robots for building protective housings on Moon (or later Mars) prior to the arrival of first astronauts.

Also 3D bioprinting, which is defined as AM with live cells is under intense investigation for applications in space. The European Space Agency (ESA) has decided to install a bioprinter in the ESA Biolab at ISS, which shall become functional in 2025. Primarily, such devices shall be utilised for the on-site fabrication of three-dimensional tissue models that can be used for exploration of the effects of space conditions like microgravity and radiation on organised human tissues and 3D cell constructs. In the long-term, bioprinting might become a powerful tool for the generation of tissues for medical treatments of injured or ill astronauts in the upcoming far-distant, manned space missions. The doctoral course shall give an overview of these fascinating developments.

Course Contents in brief:

- Topic 1: Additive Manufacturing (AM) and respective materials relevant in space flight
- Topic 2: AM of housings on the Mon using locally available materials
- Topic 3: 3D bioprinting technologies for the fabrication of living tissue models
- Topic 4: Proposed utilisation of bioprinting in manned space missions

Total # of hours of lecture: 16 hours

References:

[1] N. Cubo Mateo, S. Podhajsky, D. Knickmann, K. Slenzka, T. Ghidini, M. Gelinsky: Can 3D bioprinting be a key for exploratory missions and human settlements on the Moon and Mars? *Biofabrication* 2020, *12*, 043001.

[2] T. Ghidini: Materials for space exploration and settlement. *Nature Mater.* 2018, *17*, 846-850.

CV of the Teacher

Michael Gelinsky received his PhD in Chemistry from Freiburg University (Germany). In 1999, he moved to Dresden University of Technology (Germany) and worked for around 10 years in the Department of Materials Science, heading his own group at the newly founded Max Bergmann Center of Biomaterials from 2002. In 2010, he was appointed Professor at the Faculty of Medicine and is currently head of the Centre for Translational Bone, Joint and Soft Tissue Research. Gelinsky's work is focused on biomaterials and scaffold development, tissue engineering and regenerative therapies, mostly for musculoskeletal tissues. His group is also very active in the field of additive manufacturing (AM) of implants and 3D bioprinting technologies.

In 2020 he was appointed to become 'Fellow Biomaterials Science and Engineering' by the International Union of Societies for Biomaterials Science and Engineering. He serves as board member of the International Society for Biofabrication (ISBF) and is currently vice-president of the German Society for Biomaterials (DGBM). Michael Gelinsky is also coordinator of a Topical Team of the European Space Agency ESA on "3D Bioprinting of living tissue for utilisation in space exploration and extraterrestrial human settlements".

Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule:

Day 1 – **11:00**-12:00, 13:00-**17:30**

Day 2 – 9:00-12:00, 13:00-15:30

Day 3 – 9:00-12:00, 13:00-15:00