GeSiM 1995–2025

Bioinstruments and Microfluidics

Abstracts

GESIM

Programme

4th November

8:30 Registration

9.30 Welcome words:
30 years of GeSiM mbH
Management GeSiM mbH

9:55 Bioprinting of human cells, microorganisms and towards space!
Michael Gelinsky, TU Dresden

10:20 Modular Biofabrication for Regenerative Medicine: Precision Printing Meets Functional Biomaterials
Julia Siminska-Stanny, Université Libre de Bruxelles

10:45 Coffee break

11:25 Shaping Collagen through 3D Printing
Ina Prade, FILK Freiberg

11:50 A vascular prosthesis from a 3D-printer
Cornelia Blume, Leibniz Universität Hannover

12:15 Advancing Hierarchical Tissue Constructs through Multi-Tool Printing
Malgorzata Wlodarczyk-Biegun, Head of Biofabrication and Bio-instructive Materials

12:40 Lunch break

13:20 Guided Tour through the Hoftheater (optional)

13:40 GeSiM Machines demonstration

14:00 GeSiM Announcement - New technology release

14:20 Beyond Bioprinting: Bioscaffolder as a Versatile Platform for Drug Delivery Applications
Eneko Larrañeta, Queen's University Belfast

14:45 Space biotech for a better life
Stefan Lübcke, Managing director Yuri LUX GmbH

15:10 Advanced approaches of 3D printing in complex tissue models and patient adapted implants- From bioceramics to soft hybrid structures
Rainer Detsch, Friedrich-Alexander Universität Erlangen-Nürnberg

15:35 Coffee break

16:00 Directed chemical evolution with biosynthesizer
Stefan Görlich, B CUBE

16:25 MicroContact Printing
Marcus Soter, IBA Heiligenstadt

16:50 Space for talking to development team

17:20 Entertainment - Live music

19:00 Dinner at SchillerGarten

5th November

9:00 Living Cell Arrays: A promising miniaturized format for biomedicine and diagnostics
Rebecca Jonczyk, Leibniz Universität Hannover

9:25 Unrolling the Potential - Nanoplotting for advanced diagnostics on cylindrical hybcell micro-arrays
Christoph Reschreiter, Cube DX GmbH

9:50 To dry, or not to dry: Drop drying as a critical factor in probe immobilisation at surfaces.
Jens Sobek, Functional Genomics Center Zurich

10:15 Dots and dogs - A quick glance to spot the evidence
Licia Dossi, Cranfield University

10:40 Coffee break

11:20 Vascular modeling and therapeutic screening
Rob Krams, Queen Mary University London

11:45 Plotting 4 PoC-Detection
Philip Johnson, FRIZ Biochem GmbH

12:10 Inkjet printing of explosives trace samples.
Christian Ulrich, Fraunhofer Institute for Chemical Technology, ICT

12:35 Lunch, End of Event

Program subject to change

You can view GeSiM devices during the breaks. Our employees look forward to answering your questions.

Modular Biofabrication for Regenerative Medicine: Precision Printing meets Functionals Biomaterials

Julia Siminska-Stanny, *Université Libre de Bruxelles*

The GeSiM BioScaffolder has been central to our recent investigations in biofabrication, providing high precision and reproducibility for a wide range of biomaterials. Using **extrusion-based printing**, alginate/poly(vinyl alcohol) hydrogels incorporating magnetic nanoparticles were fabricated, allowing for controlled deposition and enabling constructs with tunable stiffness and cytocompatibility relevant to neural applications. Marine- and phenol-derived inks were investigated for shape fidelity, and dual-crosslinked tyramine-modified hyaluronic acid/gelatin methacrylate hydrogels were established, which retained their architecture and demonstrated *in vivo* biocompatibility in salivary gland models. For wound healing, protein–polyphenol and marine saccharide hydrogels were formulated that exhibited injectability, self-healing capacity, antibacterial effects, and antioxidant activity. Bacterial exopolysaccharide-based inks were further evaluated, showing enhanced stability and sustainability compared with alginate.

The **melt electrowriting** module of the BioScaffolder enabled fabrication of polycaprolactone microfibrous scaffolds with submicron resolution. Functionalization with yeast-derived bioactive peptides enhanced fibroblast proliferation, collagen deposition, and wound closure *in vivo*, providing a quantitative link between scaffold geometry, biochemical modification, and healing outcomes. **Coaxial extrusion** was employed to print perfusable PEG-tyramine vascular conduits that supported endothelial colonization and angiogenesis. **Multimaterial 4D printing** was further applied to construct patterned hydrogels with controlled distributions of magnetic nanoparticles, resulting in predictable, field-responsive behaviors such as bending, rolling, and jumping while maintaining cytocompatibility. Finally, visible-light responsive chitosan-based inks were formulated for extrusion, digital light processing, and volumetric printing, including a sacrificial system that could be selectively dissolved by light to create gravity-restricted geometries.

This presentation will cover these advances, emphasizing how the modular capabilities of the GeSiM BioScaffolder including extrusion, coaxial printing, and melt electrowriting have enabled systematic studies linking biomaterial composition, printing parameters, and scaffold function in regenerative medicine.

From Ears to Arteries: Shaping Collagen through 3D Printing

Ina Prade, *FILK Freiberg*

What happens when a classic biomaterial like collagen meets state-of-the-art additive manufacturing? In our research, we explore how this natural material can be transformed into complex, functional structures — from delicate tissue architectures and artificial blood vessels to thermoplastic collagen components for educational models and specialized applications. By combining material science with biological insight, we have developed new methods for printing collagen in both soft, cell-compatible forms and melt-processable

composites. The presentation offers an accessible overview of our work, illustrating the versatility of collagen and the key role of 3D printing in modern materials research and innovation.

Advanced approaches of 3D printing in complex tissue models and patient adapted implants: From bioceramics to soft hybrid structures

Rainer Detsch, *University of Erlangen-Nuremberg, Department of Materials Science and Engineering, Institute of Biomaterials (WW7),*
Head: Prof. Aldo R. Boccaccini

Recent advances in biomaterials have significantly impacted the fields of tissue engineering and biofabrication, offering promising alternatives to conventional methods for tissue repair and regeneration.

This presentation will highlight novel strategies in regenerative medicine, focusing on the additive manufacturing of customized scaffolds that replicate the structural and functional characteristics of native tissues. Key outcomes from recent research on 3D printing hybrid composite structures will be presented. Special emphasis will be placed on biofabrication processes that integrate living cells into hydrogels, combined with additive manufacturing, to produce three-dimensional constructs with precise control over composition, morphology, and biological function.

Our findings demonstrate that the degradation behavior of oxidized alginate–gelatin hydrogels can be finely tuned through variations in material composition and gelation conditions. In vitro studies further show that these hydrogels support and promote cellular growth and tissue regeneration.

The presentation will conclude with recent insights into the combined use of extrusion and drop-on-demand (DoD) bioprinting to modulate cell behavior in glioblastoma models. This integrated approach shows potential for engineering tumor-mimicking microenvironments and advancing the development of targeted cancer therapies.

Directed chemical evolution with biosynthesizer

Stefan Görlich and Yixin Zhang,
Technische Universität Dresden
B CUBE, Center for Molecular Bioengineering

Laboratory selection utilizes pre-constructed libraries to discover biomolecules with desired properties, but the selection approach is limited by library size, typically with a diversity in the range of millions to billions. The limitation can be circumvented by introducing mutations. However, the non-natural building blocks representing a rich source of chemical diversity and being of particular interest in drug discovery are mostly not compatible with the laboratory evolution technologies. By using the GeSiM biosynthesizer, we have realized a de novo screening system that enables the directed chemical evolution (DCEvo) of bicyclic peptidomimetics including natural and non-natural building blocks. By combining a recently developed high-throughput chemical synthesis/screening technology on a 3D matrix with chemo-informatics, we tested the DCEvo method with two bicyclic architectures, ten and fourteen

building blocks. After 2 and 4 rounds of DCEvo, low nM binders could be discovered against the RBD of SAR-CoV-2 and gastric cancer marker membrane protein Claudin18.2, respectively.

Nanoimprint Lithography for Medical Devices to Improve Blood-Contacting Surfaces

Marcus Soter, *IBA Heiligenstadt*

The functionalization of blood-contacting surfaces through nanoscale patterning offers a promising route to control thrombocyte adhesion and bacterial colonization in medical devices. In this work, nanoimprint lithography (NIL) are employed to fabricate defined micro- and nanostructures using hydrogel and polymer matrices and the GeSim µ-Contact-Printer (µCP 3.0). Agarose-based imprints demonstrate excellent anti-fouling characteristics, significantly reducing platelet attachment and activation, while maintaining biocompatibility. Furthermore, the incorporation of gold and silver nanoparticles enables the modulation of surface charge and introduces tunable antibacterial properties without compromising hemocompatibility. Systematic investigations of structure geometry, nanoparticle concentration, and material composition reveal distinct correlations between topography and biological response. These findings underline the potential of NIL-fabricated hydrogel nanostructures as a versatile platform for next-generation blood-contacting medical materials.

Unrolling the Potential: Nanoplotting for advanced diagnostics on cylindrical hybcell micro-arrays

Christoph Reschreiter, *Cube Dx*

Cube Dx uses the world's first cylindrical microarray to implement its compact sequencing, a highly sensitive and specific multiplex DNA diagnostics technology. Due to shortcomings in the production and quality assurance process, a project was started to replace the existing arraying technology. After screening of several alternative suppliers the decision was made in favour of Gesim. The Nanoplotter 2.0 was installed and expanded to handle the cyclindrical microarrays (on skewers). With help of a camera, all spots are documented after arraying. This documentation should be used to define targets / spots that do not fulfil specifications. 100% quality control is the final aim whilst still providing efficient arraying. The solution increases output per batch by about 400%. Processing time per batch is at the same time about 25% shorter.

To dry, or not to dry: Drop drying as a critical factor in probe immobilisation at surfaces

Jens Sobek, *Functional Genomics Center Zurich*

The chemical or physical immobilisation of a probe at a surface is a critical step in microarray production. The number of molecules that immobilise depends on the reactivity of probe and surface and this, in turn, to great extent on the environment within a liquid or a dried

drop. The environmental conditions determine whether the immobilisation proceeds under diffusional or solid state conditions, the latter being notoriously slow. In this talk I demonstrate how chemical reactivity can be controlled under drying and non-drying conditions.

Plotting 4 PoC-Detection

Philip Johnson, *FRIZ Biochem Gmbh*

A short introduction with emphasis on the history and relationship between GeSiM and FRIZ Biochem will be followed by a brief company presentation leading to FRIZ‘ point-of-care solution.

Going further into detail, the requirements for realizing a biofunctional microarray will show how GeSiM‘s s Nanoplotter meets all criteria for research & development as well as production of FRIZ‘ biochip.

Furthermore, the flexibility of the NP2.1 with respect to development-related changes will be shown to highlight long-term use of GeSiM‘s products and solutions.

Inkjet printing of explosives trace samples

Christian Ulrich[a]*, Frank Schnürer[a] Mario Adelhardt[b], Bastian Jacob[b]

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[b]*Bundeswehr Research Institute for Protective Technologies and CBRN Protection, WIS, 29633 Munster, Germany*

Well defined and homogeneous test materials are a crucial requirement for development and validation of trace detection systems. The commonly used preparation method of test samples - the drop-and-dry method - leads to quite inhomogeneous distribution on the test surfaces. Especially for the preparation of samples for optical stand-off technologies the drop-on-demand technique leads to samples of higher quality.

Fraunhofer ICT has long experience in printing various explosives and pyrotechnics on different substrates using a GeSiM Nanoplotter NP2.1 for providing test samples in various national, European and NATO projects in the field of stand-off detection of explosive threats. The presentation will show results of the work achieved in the NATO groups SET-237 “Printed Standards for Standoff Detection” (2016-2019) and SET-316 “Realistic trace explosives test standards for evaluation of optical sensors in relevant scenarios” (2022-2025).

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