International Conference on Biofabrication

BIOFABRICATION 2021 AUSTRALIA

27–29 September 2021

PROGRAM

MONDAY 27 SEPTEMBER 2021

0830–0900 AEST (UTC +10)	**OPENING CEREMONY** *Conference Chair:* **Prof Gordon Wallace,** *University of Wollongong* **Prof James Yoo,** *ISBF President* **Prof Patricia Davidson,** *University of Wollongong Vice Chancellor* **Prof Hugh Durrant-Whyte,** *Chief Scientist NSW Government* **Lord Mayor Gordon Bradbury,** *City of Wollongong* - **Welcome to the Gong, virtually**
0900–0940	*With thanks to our Major Sponsor* – **A word from Inventia Life Science's Dr Martin Engel** **From microtissues to regenerative medicine using drop-on-demand bioprinting technology** INVENTIA LIFE SCIENCE **Plenary I: Prof Peter Choong**, *St Vincent's Hospital, Australia* **The translational challenges for clinicians**

BREAK

0945–1120	CONCURRENT SESSION 1	CONCURRENT SESSION 2	CONCURRENT SESSION 3
Theme	Biomaterials/Bioinks/ Biopolymers	Biofabricated Tissues and Organs	Fabrication Methods and Technologies
Session Sponsor	CollPlant Pioneering Regenerative Medicine	IOP Publishing	IOP Publishing
Session Chair	*Gabriella Lindberg*	*Khoon Lim & Jinah Jang*	*Carmine Gentile & Elena Juan Pardo*
	KEYNOTE	KEYNOTE	KEYNOTE
	Dr Zhilian Yue, *University of Wollongong* **Hybrid Printing Chondral Constructs**	**Dr Riccardo Levato,** *University Medical Center Utrecht* **Bioprinting of human ductular organoids for advanced in vitro models of hepatic functionality**	**Associate Prof Payal Mukherjee,** *University of Sydney* **The role of 3D printing in Middle Ear Ossicular Reconstruction**
	Dr Sara Romanazzo, *University of New South Wales* **Omnidirectional ceramic printing in cell-matrix composites**	**Ms Monica Ortiz-Hernandez,** *Veterans Affairs Puget Sound Health Care System, University of Washington* **A bespoke, pre-vascularized, living bone graft for craniofacial reconstruction**	**Mr Daniel Whyte,** *Deakin University* **A 3D Organic Powder Printer**
	Assistant Prof Miguel Castilho, *UMC Utrecht* **Hydrogel-based bioinks for cell electrowriting of well-organized living structures with micrometer-scale resolution**	**Mr Tilman Ahlfeld,** *Technische Universität Dresden* **Biofabrication of bone grafts for alveolar cleft palates**	**Dr Naomi Paxton,** *Queensland University of Technology* **Plasma treatment improves vascularization in additive manufactured porous high-density polyethylene surgical implants for craniofacial and skeletal reconstruction**
	Miss Gretel Major, *University of Otago* **Modelling the Breast Cancer Microenvironment in vitro Using DLP Photopatterning**	**Ms Edna Johana Bolivar Monsalve,** *Tecnologico De Monterrey* **Continuous chaotic bioprinting of pre-vascularized tissue constructs**	**Dr Mylène de Ruijter,** *UMC Utrecht* **Translating Melt Electrowriting from non-planar shapes to anatomically relevant shapes for diarthrodial joint resurfacing**

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	Ms Bruna Maciel, *Karlsruhe Institute of Technology* **Using bioink structural microheterogeneities to tune their macroelasticity and study of the impact on the printing quality and cell viability**	**Dr Xiaolin Cui,** *University of Otago* **3D Bioassembly of UCBMSC-Laden Hydrogel Spheroids for Biofabrication of Hybrid Tissue Engineered Constructs in Cartilage Regeneration**	**Mr Arpan Biswas,** *University of Bayreuth* **Photoresponsive co-operative folding of 4D printed SMPs/ composites for vascular junction application**
1330–1430	**ECR Session** **"Meet the Legends" – Come meet and network with leading scientists in the field, you might score yourself a mentor!** *This is an official launch event for the ISBF mentoring programme facilitated by the Education sub-committee. 'Legends' (ie senior academics/scientists) in the Biofabrication field will be available to meet with early career researchers, to share their past experience and provide advice on career aspects and/or prospects.*		
1445–1540	**Exhibitor Showcase** — WILEY, Readily3D, TRUMPF, CELLINK LIFE SCIENCES, Rousselot Biomedical, CSIRO		
1540-1620	**Poster Session** *(Poster list on Page 12)*		
1630–1730	**BURSTER SESSION I**		

Session Sponsor: Intelligent Polymer Research Institute @ University of Wollongong

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Session Chair	**Prof Michael Higgins**
	Mr Malachy Maher, *UOW* **Comparison of collagen hydrogels for bioprinting and orthopaedic tissue engineering**
	Mrs Laura Veenendaal, *University of Otago* **3D-Bioassembly of Vitreous Humor Spheroids: Reproducibility, Fusion and Integration**
	Dr Anna Guller, *University of New South Wales* **ECM and micrometastases: the lessons from 3D engineered tumour models**
	Mr Alessandro Cianciosi, *University of Würzburg* **Optical fibre-based approach to create microfluidics platforms: simple, straightforward, and innovative solution for the generation of jammed microgel-based bioinks (m)**
	Mr Boyang Wan, *University of Sydney* **Fatigue analysis of tissue reconstruction system for therapeutical longevity**
	Mr Dong Gyu Hwang, *Postech* **Modular Assembly of 3D Bioprinted Heart Tissue to Facilitate Multiaxial Contractions**
	Ms Anna Lapomarda, *University of Pisa* **Physicochemical characterization of pectin-gelatin biomaterial ink**
	Mr Juntae Huh, *Wake Forest Institute for Regenerative Medicine* **Combinations of photoinitiator and UV absorber for cell-based digital light processing (DLP) bioprinting**
	Mr Jeremy Dinoro, *UOW* **Novel fabrication of High-Density Polyethylene via Selective Laser Sintering**
	Ms Ezgi Bakirci, *University of Wuerzburg* **Design of in vitro culture systems for neural tissue engineering using melt electrowriting**
BREAK	

LAST NAME	FIRST NAME	ORGANISATION	PAPER TITLE
Henning	Nathaniel	*Northwestern University*	**Mapping the physical properties and the contributions of matrisome proteins to ovarian folliculogenesis within an engineered microenvironment.**
Hooper	Ryan	*The Ohio State University*	**Chaotic Printing of High Surface-Area-to-Volume Filaments for Cell Expansion**
Hunt	Holly	*ACES*	**Hydrogels for Wound Healing**
Hwang	Dong Gyu	*Postech*	**Modular Assembly of 3D Bioprinted Heart Tissue to Facilitate Multiaxial Contractions**
Jing	Linzhi	*NUS (Suzhou) Research Institute*	**Noninvasive In Vivo Imaging and Monitoring of 3D-Printed Polycaprolactone Scaffolds Labeled with an NIR Region II Fluorescent Dye**
Khansari	Afsaneh	*University of Wollongong*	**Accelerated stability testing of sterilised gelatin methacryloyl (GelMA)**
Khansari	Afsaneh	*University of Wollongong*	**Sourcing biomaterials to formulate bioinks for tissue regeneration**
Mashanov	Vladimir	*Wake Forest Institute For Regenerative Medicine*	**Developing an Approach for Efficient Innervation of Bioengineered Skeletal Muscle Constructs**
Kim	Byung Chul	*Sunchon National University*	**PEDOT with Boron and Nitrogen doped graphene quantum dots on a surface modified Cu mesh for the determination of neurotransmitter**
Kisel	Anastas	*A. Tsyb Medical Radiological Research Center*	**Porous collagen bio-ink for extrusion-based bioprinting**
Kitana	Waseem	*University of Bayreuth*	**4D Biofabrication of T-Junctions as a Vascular Bifurcation**
Kleitsiotis	Panagiotis	*FORTH*	**Effects of surface's wetting properties on malaria parasites motility**
Kulaga	Anna	*University of Wollongong*	**Development of models to improve vascularisation within islet-laden constructs with 3D bioprinting**
Kumar	S Manoj	*IIT Madras*	**Scaffolds for corneal tissue engineering**
Lamb	Christopher	*University of Western Australia*	**Investigating the impact of temperature and heat flux on scaffold quality in a newly designed melt electrowriting system**
Lapomarda	Anna	*University of Pisa*	**Physicochemical characterization of pectin-gelatin biomaterial ink**
Lee	Gihyun	*Korea Advanced Institute of Science and Technology*	**Cancer cell migration and vascular network formation in a multilayered cancer microenvironment fabricated with continuous multimaterial printing**
Levato	Riccardo	*University Medical Center Utrecht*	**Biofabrication of shape-stable auricular neo-cartilage from human auricle-derived progenitor cells for the reconstruction of ear deformities**
Liu	Xiao	*University of Wollongong*	**Microporous hydrogel based bioink towards high permeability**
Liu Chung Ming	Clara	*UTS*	**In vitro Modelling of the Complex Human Heart Pathophysiology using Vascularised Cardiac Spheroids**
Lotz	Oliver	*The University of Sydney*	**Developing New Tools for Additive Biofabrication: Atmospheric Pressure Plasma Jet Treatment**
Luo	Guan-jie	*Chang Chung Memorial Hospital*	**Three-Dimensional Printing-Based Strategies for Auricular Reconstruction**
Maher	Malachy	*University of Wollongong*	**Comparison of collagen hydrogels for bioprinting and orthopaedic tissue engineering**
Masoud	Abdul-Razak	*Louisiana Tech University*	**Engineering Chitosan and Carboxymethyl cellulose Biopolymers for facilitated wound healing**
Matsuda	Riku	*Graduate School of Engineering Science, Yokohama National University*	**Multi-material microstereolithography using zirconia slurries for dental applications**
Micalizzi	Simone	*Dipartimento Ingegneria dell'Informazione (DII)*	**Extensive screening of natural and synthetic polymers for tendon regeneration**
Miklosic	Gregor	*AO Research Institute Davos*	**Extracellular matrix-based bioink for the printing of nucleus pulposus analogues**
Miyajima	Hiroki	*Yokohama National University*	**Photo-degradable GelMA based hydrogels for bioprinting**
Moldovan	Nicanor I	*Indiana Institute for Medical Research*	**3D Bioprinting of Anatomically Realistic Tissue Structures**
Moldovan	Nicanor I	*Indiana Institute for Medical Research*	**Computational Simulation of Spheroid Fusion-Based Tumor Models**
Monfared	Marzieh	*UNSW*	**Direct ink writing of cellulose nanofibrils bio-hydrogels**
Moon	Ji Hwan	*Hanyang University*	**Self-healing electromagnetic interference shielding based on graphene oxide/silver nanowire composite**
Mungenast	Lena	*FHNW*	**Electrospun extracellular matrix fibers as scaffolds for neural regeneration**

Modular Assembly of 3D Bioprinted Heart Tissue to Facilitate Multiaxial Contractions

Mr Dong Gyu Hwang[1], Mr Uijung Yong[2], Ms Jinah Jang[1,2,3]
[1]School of Interdisciplinary Bioscience and Bioengineering, Pohang University of Science and Technology, Pohang, Republic of Korea, [2]Department of Convergence IT Engineering, Pohang University of Science and Technology, Pohang, Republic of Korea, [3]Department of Mechanical Engineering, Pohang University of Science and Technology, Pohang, Republic of Korea

Biography:
Mr. Dong Gyu Hwang is a MS and Ph.D. course student in the School of Interdisciplinary Bioscience and Bioengineering at Pohang University of Science and Technology (POSTECH) in the Republic of Korea. He received his Bachelor's degree in Biomedical Engineering from Dongguk University, Seoul, the Republic of Korea in 2017. He starts his research after joined Prof. Jinah Jang's group in 2018. His research is focused on 3D bioprinting of engineered multi-scale encapsulation system for islet transplantation, and iPSC-derived engineered heart pump for in vitro application. He awarded Global PhD Fellowship (NRF) from 2019.

Cardiovascular disease is the leading cause of death in the world, and the treatments and prognoses are diverse due to complicated disease mechanisms. Therefore, the heart has been studied in a laboratory to understand its function in health and disease and to test the safety and efficacy of potential therapeutics.

An engineered heart tissue (EHT) derived from human induced pluripotent stem cells (hiPSCs) enables to study of human pathophysiology. The spheroid has been utilized as a basic model to generate multicellular cardiac tissues. In addition, strip- or ring-type EHT has been developed to study contractility and electrophysiological properties of the native heart. As an alternative, modular tissue engineering is a bottom-up fabrication approach to creating larger or more complex construct using small building blocks. Most of the EHT models generated using modular tissue engineering were fabricated in the form of strips, rings, or cylinders based on spheroid building blocks. Recent advances in 3D bioprinting technology allow fabricating cardiac chamber-like structures that reproduce volume-pressure relationships. Although these models are well-established to represent cardiac-specific features, the orientation of cardiac muscle fibers to maximize blood ejection has not been achieved.

In this study, we suggest a strategy to modulate the contractile direction of cardiac tissue. Using the versatility of 3D bioprinting technology, we manufactured various sizes and shapes (strip and ring) of EHT modules (m-EHTs), which have a contraction direction individually. as a building block. In brief, poly(ethylene-co-vinyl acetate) (PEVA) constructs were designed to consist of posts and connecting parts. The post is devised to provide tensile stress to the m-EHT in the opposite direction of tissue contraction. The connecting parts are designed to attach the multiple m-EHTs to ensure sufficient assembly. Then, iPSC-derived cardiomyocytes (iPSC-CMs) were mixed with cardiac fibroblasts (CF) and human umbilical vein endothelial cells (HUVECs) within the porcine heart-derived extracellular matrix (hdECM) and printed onto the PEVA construct to form EHT.

The developed m-EHTs were confirmed to form well-aligned cellular structures. In addition, these models exhibited spontaneous and synchronized contractile force, electrophysiological properties, and drug responsiveness. Afterward, the m-EHTs were assembled to create complicated EHT models (A-EHTs) that could generate multiaxial contractions. We investigated the changing contractility when assembling m-EHTs (strip-strip) of the same type in series or in parallel. Furthermore, we also examined varying contractility by assembling different types of m-EHT (ring-strip). Finally, A-EHT which generates multiaxial contractions was developed.

These results could further be advanced to build swirling musculature of cardiac ventricle chamber which could generate effective contraction to eject blood. Moreover, the heart model will be utilized as promising tools for a wide range of applications such as drug screening, tissue regeneration, as well as a platform for disease models with more biomimetic conditions.