*The **CREA**tion of the Department of Physical Chemistry of Biological Sys**TE**ms [CREATE]*

666295 — CREATE — H2020-WIDESPREAD-2014-2015/H2020-WIDESPREAD-2014-2

Report on the *Industrialization Potential of Optics in Biomedicine* conference

Level of dissemination: Public

Warsaw, March 2021

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 666295

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1. "Industrialization Potential of Optics in Biomedicine" Conference

On 7th and 8th of October, 2020, the conference entitled **Industrialization Potential of Optics in Biomedicine** took place. IPC PAS organised the conference as part of WP5 of the CREATE project. Due to the pandemic, the event had an online form. All lectures and talks were broadcast via the conference channel (Pine conference platform) and streamed live on YouTube and FB.

208 participants registered for the conference. There were also many non-registered observers on YouTube, from 80 scientific centres from all over the world, including China, Denmark, Finland, France, Great Britain, United States and even New Zealand, not to mention many reputable Polish universities and institutes.

The scientific committee of the conference was composed by:

- Prof. Maciej Wojtkowski - ERA Chair holder (IPC),
- Prof. Małgorzata Kujawińska (Faculty of Mechatronics, Warsaw University of Technology),
- Prof. Christophe Gorecki (International Center for Translational Eye Research, Warsaw)
- Prof. Krzysztof Palczewski (Gavin Herbert Eye Institute, UCI).

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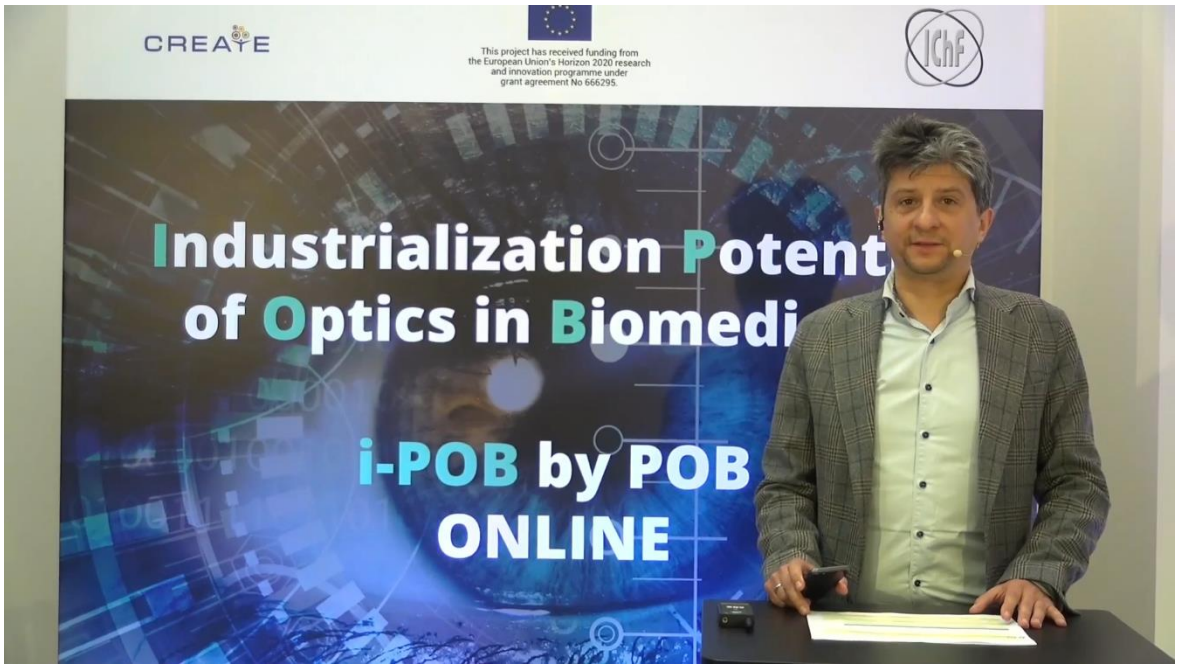
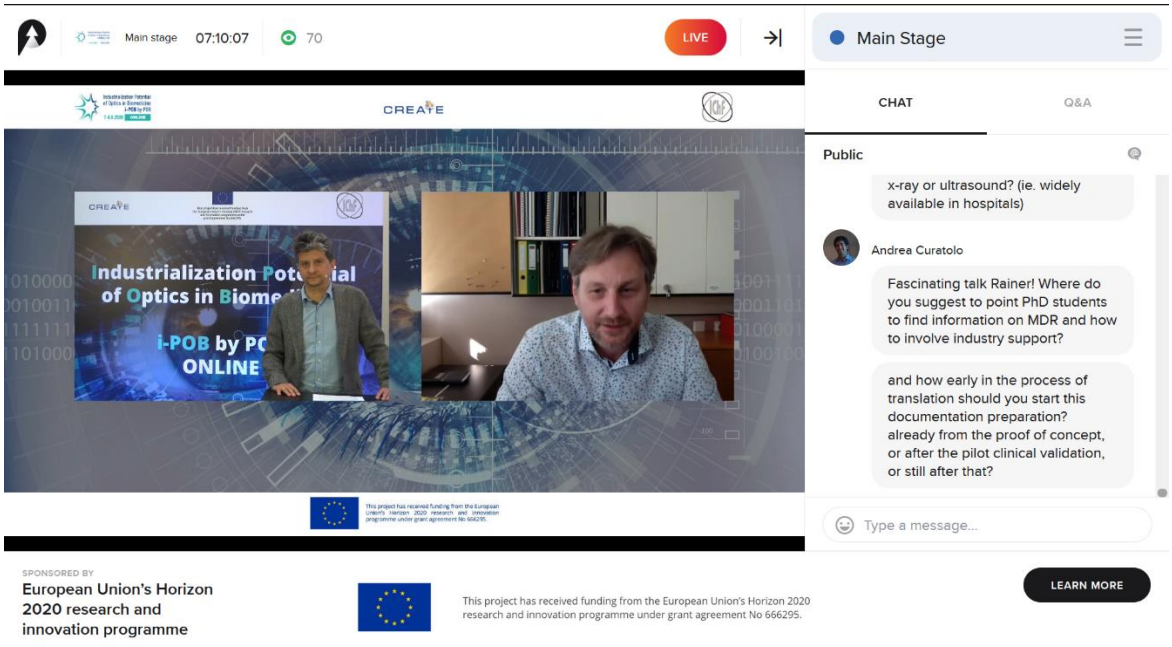
The conference focused on the past, current and future developments of optical biomedical imaging techniques. The i-POB conference programme provided an opportunity to share the experience and tribulations of taking discovery to the global market, successfully implementing new technologies and running the high-tech company. The event provided a platform for interaction between scientist, innovators and entrepreneurs. It was especially instructive for junior researchers and inventors interested in the development of novel imaging technologies.



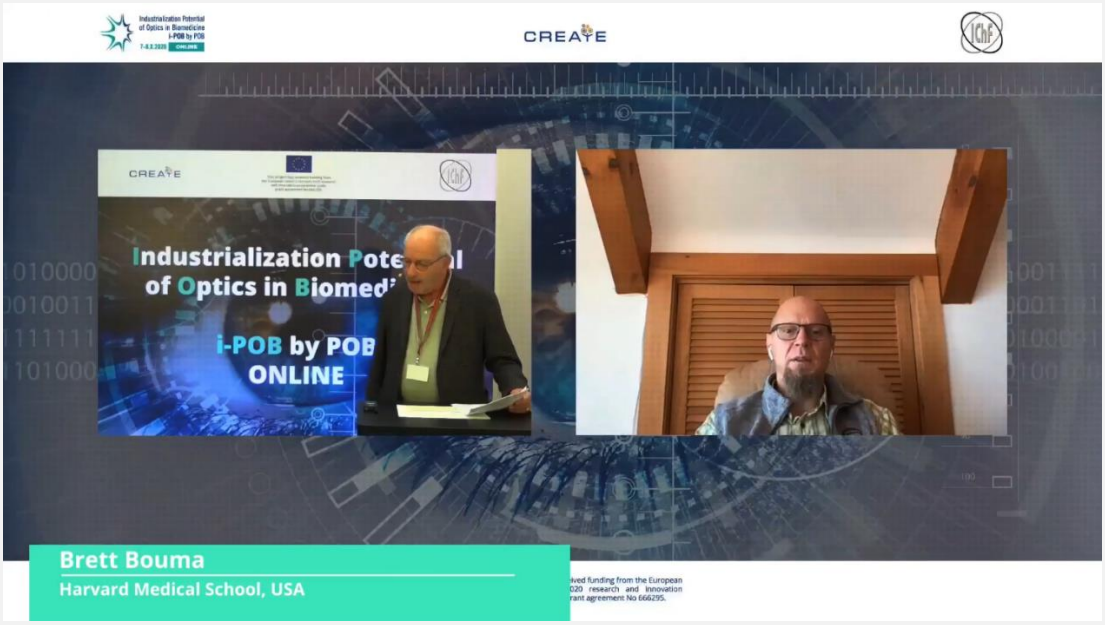


During the two-day conference, participants could choose from six sessions presenting different facets of optics in biomedicine. As the whole event was interactive, participants could listen to lectures and ask questions and voice their personal opinions on presented subjects. The detailed agenda of the conference is available on the conference website: http://i-pob.edu.pl/.

Lectures and talks of keynote speakers that enriched the conference (each talk gather ca. 200 participants):

Name:	**Prof. Brett Bouma**
Position/Institution:	**Professor of Dermatology and Health Sciences and Technology, Harvard Medical School Physicist, Massachusetts General Hospital Director, USA**

Prof. Brett Bouma is a Professor of Dermatology and Health Sciences and Technology at Harvard Medical School, Director of the Center for Biomedical OCT Research and Translation. He has published over 230 manuscripts that collectively accumulated over 53,000 citations, reflecting an h-index of 67 (Web of Science) and 106 (Google Scholar). Prof. Bouma's research has led to over 300 issued/allowed patents, with over 100 additional patent applications pending. Many of his patents have been licensed to four different companies, resulting in 5 distinct medical devices on the market. In addition, he serves on the scientific advisory boards of several companies.



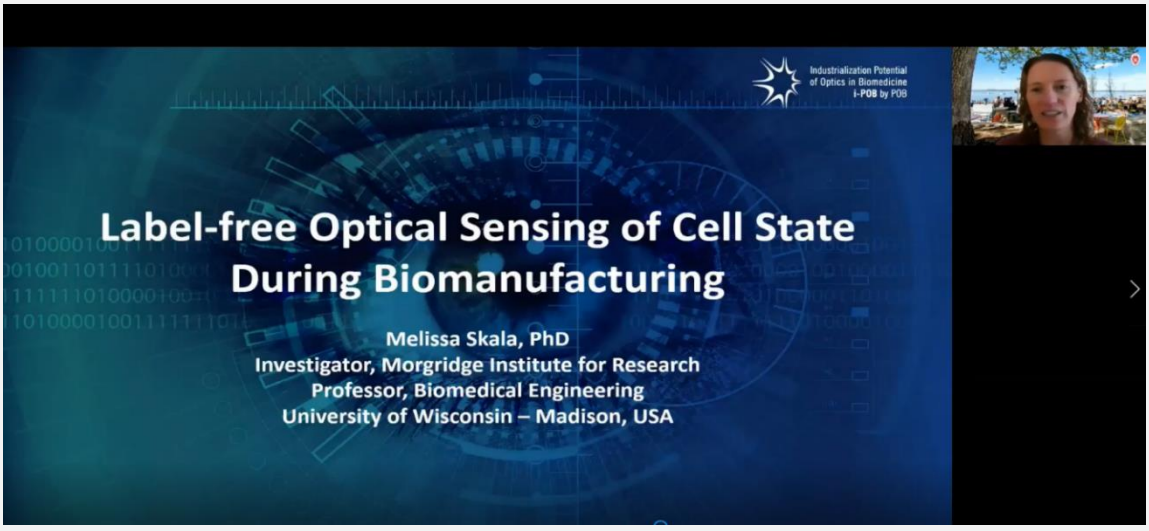
"The development and commercialisation of endoscopic OCT technology"

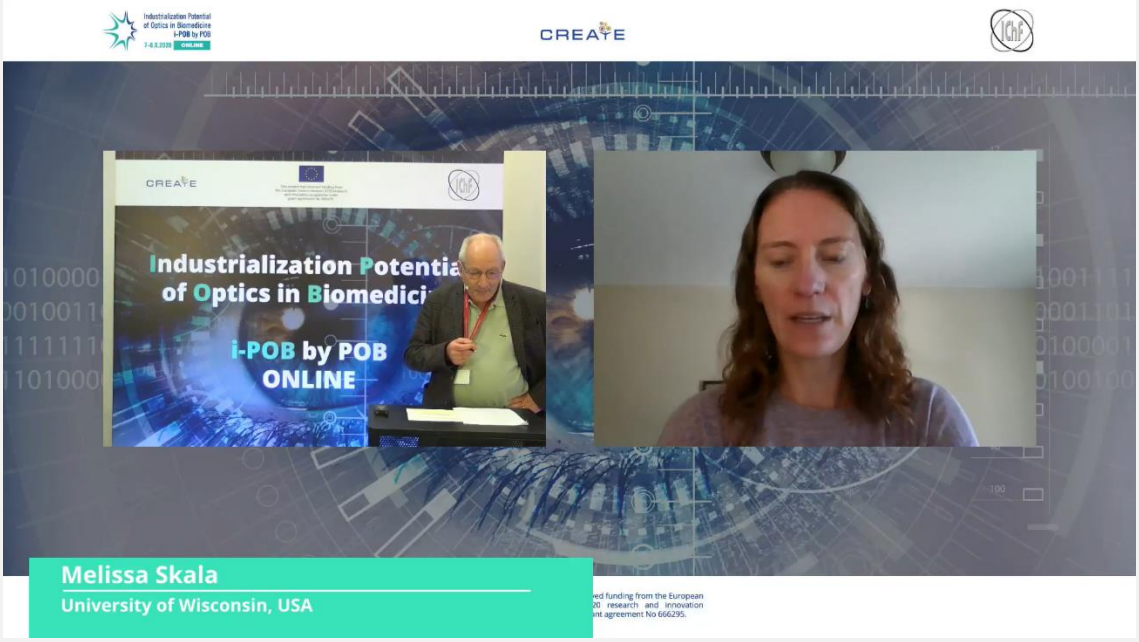
Abstract of the seminar

The lecture will include an overview of the clinical challenges associated with esophageal adenocarcinoma and its precursor condition Barrett's Esophagus. The requirements for screening and surveillance were identified as primary motivators that drove the development of endoscopic OCT. The image features associated with dysplasia and intramucosal cancer were presented, and the strategy for imaging and laser marking was discussed. The pathway of commercialisation that has resulted in the clinical availability of OCT systems for endoscopic use was reviewed.

Name: **Prof. Melissa Skala**
Position/Institution: **Professor at Morgridge Institute for Research, University of Wisconsin, USA**

Melissa Skala is an Associate Professor of Biomedical Engineering at the University of Wisconsin – Madison and an Investigator at the Morgridge Institute for Research. She received her Ph.D. in Biomedical Engineering at Duke University in 2007. Her lab uses photonics-based technologies to develop personalized treatment plans for cancer patients, including breast, pancreatic, colorectal, neuroendocrine, oral, and other cancers. She was honoured with the OSA Fellowship.





„ Label-free Optical Sensing of Cell State During Biomanufacturing"

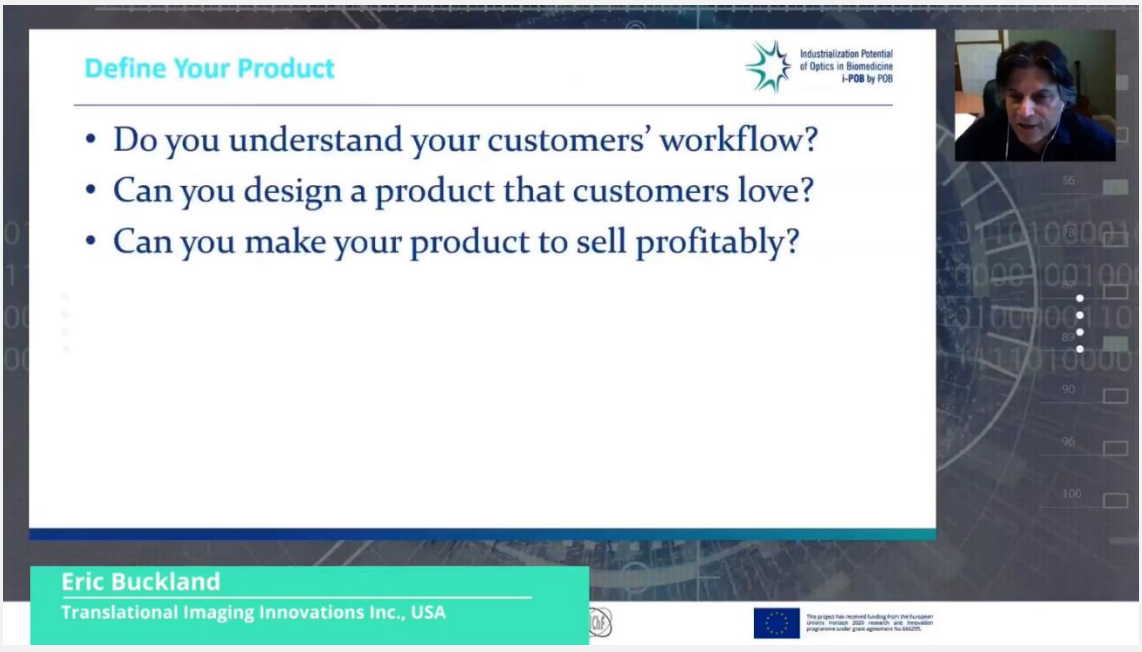
Abstract of the seminar

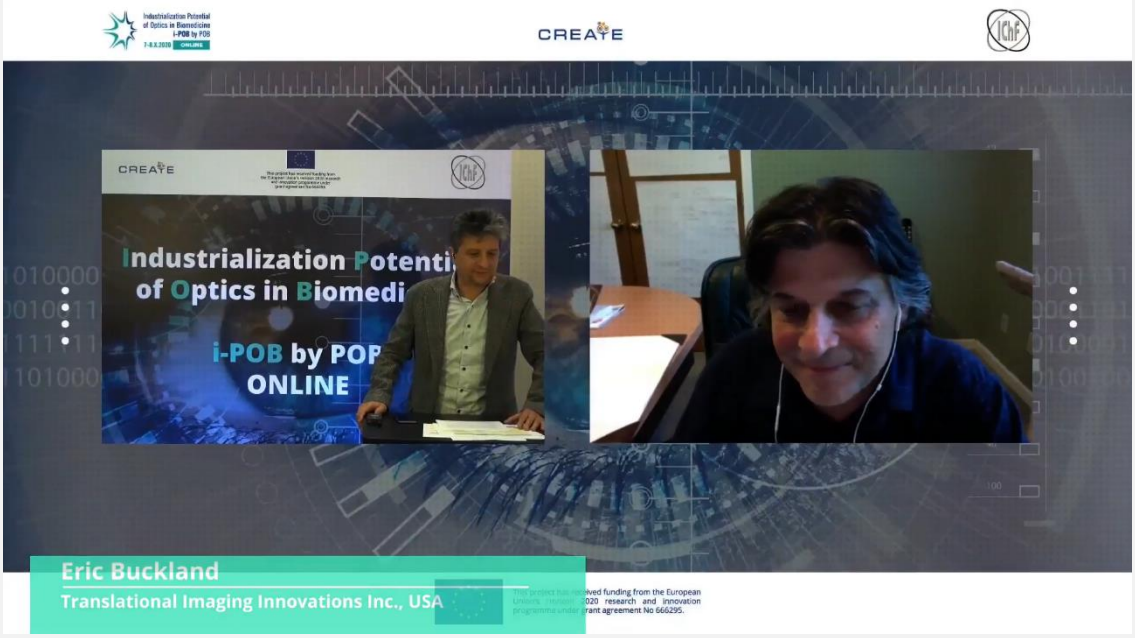
Cell-based therapies have the potential to treat or even cure a myriad of diseases. However, these complex biological products display intrinsic variability within a tightly regulated industry. Process optimisation and thorough product characterisation prior to clinical development is critical. Typical quality assessments require labels to characterise functional subsets of cells. However, standard analytics are laborious, time-consuming, susceptible to reagent quality variability, and may potentially alter cell function. To improve the fidelity of quality assessments, we have developed a label-free, nondestructive optical detection approach to quantify overall cell state, viability, and activation with single-cell resolution. The technology is based on the autofluorescence lifetime of the metabolic co-enzyme NAD(P)H. T cells isolated from human peripheral blood and activated in culture using tetrameric antibodies against the surface ligands CD2, CD3 and CD28 showed specific activation-state-dependent patterns of autofluorescence NAD(P)H lifetime. Logistic regression models and random forest models classified T cells according to activation state with 97–99% accuracy and according to activation state (quiescent or activated) and subtype (CD3+CD8+ or CD3+CD4+) with 97% accuracy. The hardware, optics, and analytical algorithms are readily integrated into a variety of quantitative imaging technologies, such as flow and image cytometry, enabling non-destructive assessment for early stage cell manufacturing process optimisation and streamlining product development as therapies transition to commercial scale manufacture.

Name: **Dr. Eric Buckland**

Position/Institution: **Founder and CEO at Translational Imaging Innovations, USA**

Dr. Eric Buckland is a Founder and CEO of Translational Imaging Innovations, Inc. He has 30 years of experience in developing and commercializing optical technologies for imaging, metrology, and telecommunications. He is a founder and CEO of Bioptigen, an international brand recognized for superior imaging systems in translational research, pediatric, and surgical ophthalmology, sold to Leica Microsystems in 2015. Dr. Buckland has 70 patents, 5 Phase II SBIRs.





"Romancing the Start-up: Starting the Entrepreneurial Journey on the Right Foot"

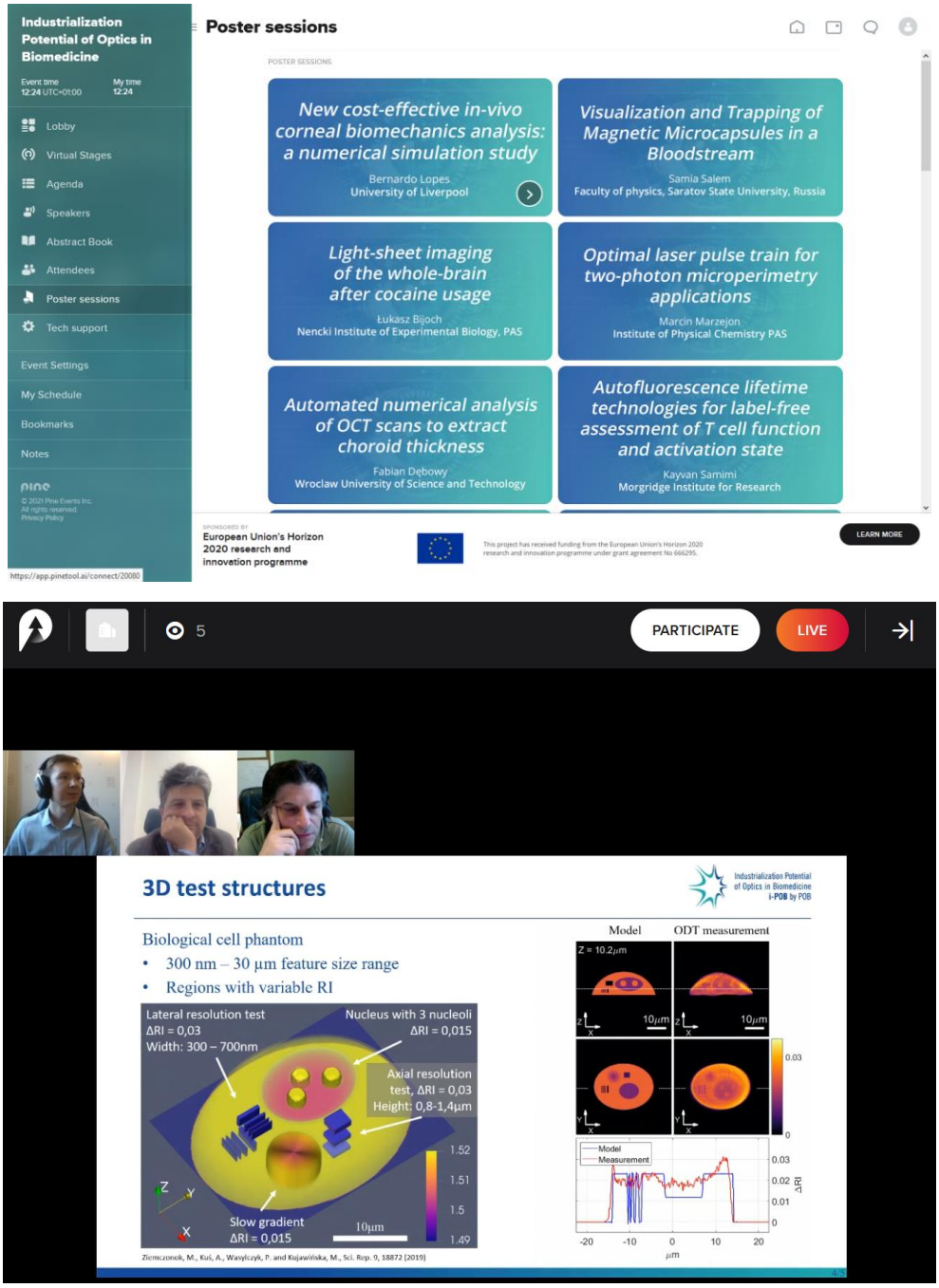
Abstract of the seminar

Start-ups are romantic, even mythical. There is perhaps nothing more exciting in a career than capturing a Unicorn with the better-mousetrap we invented during our Ph. D. programs. The problem is that Unicorns are rare, and better mousetraps seem to be everywhere. To succeed with sanity intact, we need to come down to earth and get real. Taking the right steps from the beginning maximises our chance at building not just a better mousetrap, but a business worthy of growing into that elusive Unicorn. We will discuss the earliest stages of business formation, starting with our co-founders, and proceeding through our first phases of funding, development, and market validation. We will discuss essential topics such as founder agreements, intellectual property rights, and negotiating licenses from our institutions, establishing product-market fit, and early-stage financing. Our objective is to remove the mythology from the start-up experience. We can retain the romance.

The speakers shared their knowledge, expertise, and personal experience in optics and transferring scientific knowledge into well-prospering businesses. The event was also a unique opportunity for junior scientists and inventors interested in developing novel imaging technologies to interact with more experienced colleagues and entrepreneurs.

On the second day of the conference, a poster session was organised during which early stage researchers could present their scientific achievements and projects in the form of short (few slides) presentations. It was an excellent opportunity for them to discuss their research results with more experienced scientists and obtain expert opinions on how to successfully conduct commercialisation projects, start the company, and enter the global market.

During the poster session, a competition for the best online poster took place. Evaluation committee composed of prof. Brett Bouma, dr. Melissa Skala, dr. Eric Buckland and prof. Christophe Gorecki awarded **two main prizes – for Kayvan Samimi and Michał Ziemczonok**. The winners received diplomas (see **Annex 1** for an example of a diploma) and **an invitation to an internship at the Physical Optics and Biophotonics Group.**



Poster session, PINE platform, 2nd day of the conference

A complete list of the lectures delivered during the conference and the titles of the presented posters are shown in **Annex 2.**

Undoubtedly, the conference was a great success and the participants left with not only new knowledge but also valuable contacts. The video reportage from the i-POB conference is available on YouTube: https://www.youtube.com/watch?v=uT95u__Svkk

Full conference recordings are available here:

Day 1 – https://www.youtube.com/watch?v=IxQWSGfwRgo&t=2256s

Day 2 – https://www.youtube.com/watch?v=iaok1UukKVw&t=6s

ANNEX 1

Diploma for the winner of the Best Poster Award

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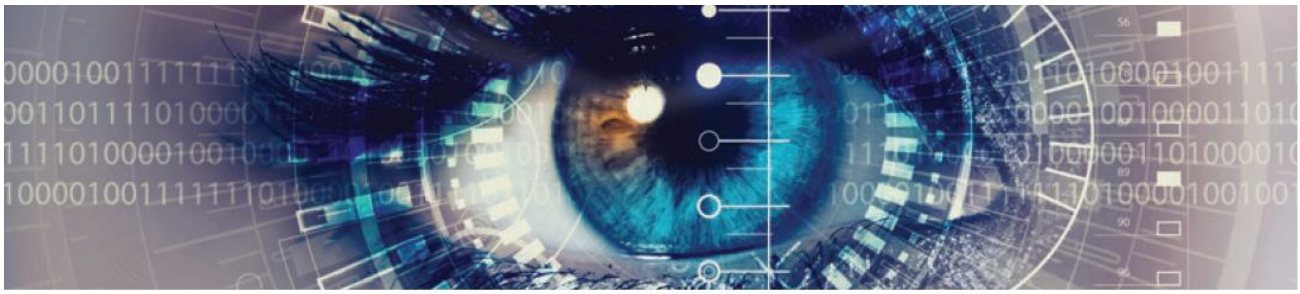

BEST POSTER AWARD CERTIFICATE

The certificate is granted to

Kayvan Samimi

the winner of the Best Poster Award
(ex aequo)
for the poster titled

"Autofluorescence lifetime technologies for label-free assessment of T cell function and activation state."

presented at

Industrialization Potential of Optics in Biomedicine Conference

held online by

the Institute of Physical Chemistry
Polish Academy of Sciences, Warsaw
on 7-8 October 2020

On behalf of the competition referees:

Prof. Maciej Wojtkowski
Warsaw, 16.10.2020

Industrialization Potential of Optics in Biomedicine i-POB by POB 7-8.X.2020 ONLINE

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ANNEX 2

Conference program incl. a list of the lectures and the titles of the poster presentations

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Conference Programme

Day 1 : 07.10.2020

12:50 - 13:00	Welcome **Host: Maciej Wojtkowski**
13:00 - 13:30	**Special event: dr Yann Cotte**, Nanolife SA, Switzerland *For registered participants only*
13:40 - 15:00	Session 1 **Host: Maciej Wojtkowski**
13:40 - 14:00	**Brendan Kennedy, Harry Perkins** , The University of Western Australia / Institute of Medical Research, OncoRes Medical, *In vivo detection of residual tumour in breast-conserving surgery using OCT based elastography*
14:10 - 14:30	**Robert Huber**, Institute of Biomedical Optics, University of Lubeck, Germany *4-D Megahertz-OCT: Technology and applications*
14:40 - 15:00	**Egidijus Auksorius**, Institute of Physical Chemistry PAS, Poland *Crosstalk-free volumetric in vivo imaging of a human retina and cornea with Fourier-domain full-field optical coherence tomography*
15:10 - 15:30	Break
15:30 - 16:50	**Session 2** **Host: Christophe Gorecki**
15:30 - 16:00	**Brett Bouma**, Harvard Medical, School, USA, *The development and commercialization of endoscopic OCT technology*
16:10 - 16:40	**Melissa Skala,** Morgridge Institute for Research, University of Wisconsin, USA, *Label-free Optical Sensing of Cell State During Biomanufacturing*
16:50 - 17:00	Break
17:00 - 18:30	**Session 3** **Host: Maciej Wojtkowski**
17:00 - 17:20	**Eric Buckland**, Translational Imaging Innovations, USA, *Romancing the Startup: Starting the Entrepreneurial Journey on the Right Foot*
17:30 - 17:50	**Mary Durbin,** Zeiss Meditec, USA, *Developing and verifying quantification for OCT Angiography*
18:00 - 18:20	**Grazyna Palczewska,** Polgenix, USA, *Beauty and power of two-photon excitation*

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Day 2 : 08.10.2020

9:00 - 10:30	**Session 1** **Host: Karol Karnowski**
9:00 - 9:20	**Andrea Curatolo,** Instituto de Óptica "Daza de Valdés", Consejo Superior de Investigaciones Científicas (IO, CSIC), Madrid, Spain, *High-frame rate multi-meridian corneal imaging of air puff induced deformation for improved detection of keratoconus*
9:30 - 9:50	**Thomas Klein**, Optores, Germany, *High finesse tunable Fabry-Perot filters in Fourier-domain mode-locked lasers*
10:00 - 10:20	**Huikai Xie,** Beijing Institute of Technology, China, *MEMS Scanning Micromirror Based Multimodal Optical Endoscopic Imaging*
10:30 - 11:30	**Session 2** **Host: Piotr Ciąćka**
10:30 - 10:50	**Yves Emery,** Lyncee Tec SA, Switzerland *From pioneer publications to commercial expansion*
11:00 - 11:20	**Arkadiusz Kuś**, Faculty of Mechatronics, Warsaw University of technology, Poland *Single exposure holographic tomography*
11:30 - 11:40	Break
11:40 - 13:40	**Session 3** **Host: Maciej Wojtkowski**
11:40 - 12:00	**Rainer Leitgeb,** Medical University of Vienna, Austria, *Research at the edge of translation*
12:10 - 12:30	**Fergal Shevlin,** Dyoptyka, Ireland *Successful commercialization of a novel optical technology by a small start-up*
12:40 - 13:00	**Dawid Borycki**, Institute of Physical Chemistry PAS, Poland, *Sensorless adaptive optics and angiography in spatiotemporal optical coherence (STOC) retinal imaging*
13:10 - 13:30	**Nishant Mohan,** Photonicare Raleigh-Durham, Il, USA, *Industrial Advances Enabling OCT Adoption in Primary Care: From Commercial Optimization to Artificial Intelligence*
13:40 - 14:30	Lunch break
14:30 - 17:30	**Poster session** *(The Best online poster award competition referees: Brett Bouma, Melissa Skala, Eric Buckland, Christophe Goreck)*
18:00 - 18:30	**Conclusions, Best poster Award and Closing** **Host: Maciej Wojtkowski**

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List of poster presentations

Bernardo Lopes University of Liverpool	*New cost-effective in-vivo corneal biomechanics analysis: a numerical simulation study*
Samia Salem Faculty of Physics, Saratov State University, Russia	*Visualization and Trapping of Magnetic Microcapsules in a Bloodstream*
Łukasz Bijoch Nencki Institute of Experimental Biology, PAS	*Light-sheet imaging of the whole-brain after cocaine usage*
Marcin Marzejon Institute of Physical Chemistry PAS	*Optimal laser pulse train for two-photon microperimetry applications*
Fabian Dębowy Wroclaw University of Science and Technology	*Automated numerical analysis of OCT scans to extract choroid thickness*
Kayvan Samimi Morgridge Institute for Research	*Autofluorescence lifetime technologies for label-free assessment of T cell function and activation state*
Agnieszka Zielińska Nicolaus Copernicus University in Toruń	*Two-photon pupillary light reflexes*
Saeed Samaei Polish Academy of Sciences	*Compact time-domain diffuse correlation spectroscopy instrument for depth-resolved blood flow quantification in vivo*
Grzegorz Soboń Wrocław University of Science and Technology	*Novel femtosecond fiber laser with tunable pulse repetition rate for two-photon excited fluorescence imagining*
Maria Baczewska Warsaw University of Technology	*Statistical analysis of cell compartments in 2D and 3D QPI tools*
Fernando Eleazar García Ramírez FEMTO-ST Institute	*SS-OCT probe with a Mirau micro-interferometer and a 2-axis electrothermal micro-mirror scanner for endoscopic applications*
Alejandra Consejo Institute of Physical Chemistry PAS	*Detection of subclinical keratoconus based on Scheimpflug light intensity distribution*
Klaudia Nowacka Institute of Physical Chemistry PAS	*Dynamic light scattering improves imaging with optical coherence tomography*
Ewelina Pijewska Uniwersytet Mikołaja Kopernika	*Estimation of blood circulation in the human retina vessels by spectral and time-domain optical coherence tomography*
Krystian Wróbel Institute of Physics, Nicolaus Copernicus University in Toruń	*Extracting information from saccades and microsaccades detected with an ultrafast retinal tracking system*
Alfonso Jiménez-Villar Nicolaus Copernicus University	*Air-puff SS-OCT biometer for non-contact determination of biomechanical properties of the eye*
Ebrahim Safarian Baloujeh Nicolaus Copernicus University	*OCT-Based Densitography for Objective Determination of Crystalline Lens Opacities*
Daniel Rumiński Nicolaus Copernicus University	*Image-Based Evaluation of Vitreous Aging Process in the Human Eye*

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Maciej Nowakowski AM2M R&D Ltd.	*Research and development processes in biomedical optics field*
Anna Szkulmowska AM2M R&D Ltd.	*Quality improvement of OCT images*
Michał Meina Nicolaus Copernicus University	*Zero-latency retinal movement tracker with a high spatial and temporal resolution*
Szymon Tamborski Nicolaus Copernicus University	*Fast and precise retinal eye-tracking system for quantification of fixational and saccadic motion*
Michał Ziemnoczok Warsaw University of Technology	*Test structures for metrology in 2D/3D phase microscopy*
Joanna Gorgol Nicolaus Copernicus University	*Analysis of eye movements during fixation task using FreezEye Tracker – a pilot study*

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