Polat GOKTAS

Technology Centre:	CeADAR – Ireland's Centre for Applied Artificial Intelligence, UCD
Academic Mentor:	Dr. Ricardo Simon Carbajo
Company Partner:	ValitaCell Ltd
Company Mentor:	Dr. Paul Dobson

Polat Goktas received his Bachelor's degree as a valedictorian of Electrical and Electronics Engineering at Ankara University, Ankara, Turkey and completed his MSc. and Ph.D. degree in Electrical and Electronics Engineering at Bilkent University, Ankara, Turkey. During his MSc. he worked on several projects, including simulation and experimentation of electromagnetic propagation for commercial wireless communication and radar systems. During his MSc. studies he co-authored papers and received the "Dr. Akin Cakmakci Industrial Application Thesis Award of 2016". He also received the "Best Paper Award" of the National Defense Application in Modeling and Simulation Conference of Turkey in 2016. Moreover, he was selected among a number of institute nominees across the country to represent Turkey in the 66th Lindau Nobel Laureates Meeting, Germany dedicated to the field of Physics, 2016.

His Ph.D. research is a highly interdisciplinary mix of image acquisition, image processing, data analysis and life sciences. His main project was on the analysis and experimental study of single biological cells especially for red blood cells, to identify cellular information without staining for label-free, high throughput classification and detection of cellular information at the single cell level, especially for *in vitro* diagnostic research. For the 2017-18 year, he continued his research activities in the Bio-Optics Laboratory of the Wellman Center for Photomedicine, Harvard Medical School on a Fulbright Doctoral Research Fellowship. In addition, he participated in the Molecular HematoPhysiology Laboratory in the School of Medicine, Koc University, as a visiting Ph.D. researcher for the 2018-19 year.
During his Ph.D. studies, he received a Fulbright Doctoral Research fellowship and IEEE AP-S Doctoral Research Grant (ranked as the best Ph.D. student in the area of Electromagnetics in the worldwide) for the 2017-18 year, and the 2019 Leopold B. Felsen Excellence in Electromagnetics award.

Dr. Ricardo Simon Carbajo, Head of Innovation & Development at CeADAR

Simon Carbajo is the Head of Innovation and Development in CeADAR. He leads the IDG group, composed of senior data scientists, which focuses on the development of bespoke advanced data analytics and applied research AI solutions for SMEs and MNCs operating in a large range of verticals (energy, manufacturing, insurance, fintech, healthcare, telecoms, etc.)
Prior to this position, Ricardo was Lecturer, Senior Research Fellow and Post-Doctoral Researcher in Trinity College Dublin, University College Dublin and Dublin City University.
Ricardo holds a PhD in Computer Science from Trinity College Dublin (Ireland). His applied research background includes areas such as wireless networking, distributed systems, signal processing, sensor data fusion, real-time data analytics and advanced machine learning.
Ricardo also has experience in entrepreneurship, as founder of a start-up company in the Industry 4.0 sector.

Dr. Carbajo said: "AI can massively help to improve the Biopharma value chain.
In this project, we will be applying the latest techniques in Computer Vision to speed up the process on manufacturing stem cells. We are delighted to partner with ValitaCell as they are truly innovating in this area and we can produce a real impact in society."

Dr. Paul Dobson, Head of Data at ValitaCell

Paul has spent >20 years working at the interface between Biology, Computer Science and Engineering. He has published >35 peer-reviewed original articles, reviews and book chapters on drug discovery, systems biology and bioprocessing. As Head of Data at ValitaCell, he has overseen trials and product launches, and represented the company at conferences and on panel discussions. In his previous academic role as a Lecturer in Biomanufacturing at the University of Sheffield (UK), Paul led a team of PhD and postdoctoral researchers applying bioinformatics, process modelling and AI to improve biopharmaceutical manufacturing.

Dr. Dobson said: "Working with CeADAR will help ValitaCell leverage the power of Deep Learning to create better bioprocess analytical technologies to support stem cell therapy manufacturing. This will help translate stem cells from being a niche experimental therapy into a treatment available to patients worldwide."

Center for Applied Data Analytics (CeADAR)

CeADAR is the National Centre for Applied Artificial Intelligence. Funded by EI and the IDA, CeADAR has more than 90 member companies across a wide span of industries and is Ireland's Digital Innovation Hub, delivering AI services to industry nationally and in Europe. The primary work of the Centre is on cutting-edge applied research, developing and deploying industry prototypes and solutions for companies. CeADAR is also very active in European research projects, spinouts, industry upskilling and has its own high-performance computing infrastructure.

www.ceadar.ie

ValitaCell Ltd

Established in 2014, ValitaCell is an award-winning Irish SME that produces innovative products and technologies for the biopharmaceutical industry. ValitaCell's products enable biopharmaceutical companies to bring drugs to the market quicker, cheaper and with greater regulatory confidence.

www.valitacell.com

DeepStain: Deep Learning for Cell Image Analysis

Biological therapeutics are amongst the most commercially and clinically valuable medicines available. Stem cells represent a novel therapeutic approach for the treatment of many chronic diseases, but their routine manufacturing remains a major challenge to widespread clinical use. To assess the therapeutic quality of stem cells while they are being expanded and before transplantation, it is necessary to monitor stem cell identity, health, ability to deal with stress *etc.* Many current cell tests depend to a great extent upon chemical staining to highlight key cell parts or or assess functional traits. However, staining is expensive, slow and laborious to apply, and tends to damage cells. If we could extract the same information without staining, we could identify good production cells more simply and quickly. This would allow us, through improving process design and process analytics, to solve the stem cell manufacturing problem and so make stem cell therapies accessible to all.

High-throughput imaging has recently made great strides through automated image analysis techniques. Most current image analyses segment images into single cells, then hundreds of features are calculated per cell. However, defining and optimizing good features is challenging and time-consuming. To overcome this, convolutional neural networks (convnets) have been developed for biological image processing. Convnets work better because they automatically identify optimal features to describe cells from raw images.

We will apply an innovative convnet for image-to-label translation to predict cell staining results. We will also use image-to-image translation UNets and Generative Adversarial Networks (GANs) to generate synthetically-stained images that closely mimic actual-stained images. State-of-the-art models built by the commercial partner indicate a solid proof-of-concept for convnets and Unets, but further work is required to improve these, assess their generalization potential and dissect how they work by Explainable AI.

By building upon the company's early proofs-of-concept and laboratory testbeds, we will create the first robust, productized DL predictors to for use in bioprocessing. This will help translate the potential of stem cell therapies from promising clinical trial results to a game-changing therapeutic accessible to patients around the World.