

**MIDL**

**Amsterdam 2018**

**Conference book**









# MIDL 2018

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## CONFERENCE AT A GLANCE

### Wednesday July 4th

08:45	09:00	Opening remarks
09:00	09:40	Keynote speaker: <b>Dr. Graham Taylor, University of Guelph</b>
09:40	10:40	Oral session I: <b>Novel extensions to convolutional networks (1)</b>
10:40	11:10	Coffee Break
11:10	12:30	Oral session II: <b>Alternative DL architectures</b>
12:30	14:00	Lunch
14:00	14:40	Keynote speaker: <b>Prof. Ronald Summers, NIH</b>
14:40	16:15	Poster session I
16:15	19:00	Free time
19:00	21:00	<b>Reception and Welcome Dinner</b>

### Thursday July 5th

09:00	09:40	Keynote speaker: <b>Dr. Adriana Romero, Facebook AI Research</b>
09:40	10:40	Oral session III: <b>Novel extensions to convolutional networks (2)</b>
10:40	11:10	Break
11:10	12:30	Oral session IV: <b>Medical image enhancement, generation and reconstruction</b>
12:30	14:00	Lunch
14:00	14:40	Keynote speaker: <b>Dr. Tim Salimans, Open AI</b>
14:40	16:15	Poster session II
16:30	19:00	Drinks at Aidence (see conference website for more details on signing up)

### Friday July 6th

09:00	10:00	Oral session V: <b>Uncertainty estimation and reinforcement learning</b>
10:00	11:30	Poster session III
11:00	11:30	Coffee Break
11:30	12:10	<b>Panel discussion</b>
12:10	13:30	Lunch
13:30	14:50	Oral session VI: <b>Weakly supervised and unsupervised learning</b>
14:50	15:10	<b>Awards ceremony</b> and closing remarks
15:10		Demo session and drinks

## MESSAGE FROM THE CHAIRS

Welcome to the first conference on Medical Imaging with Deep Learning, or MIDL (pronounced as "middle").

The Editor in Chief of IEEE Transactions on Medical Imaging (TMI) recently wrote in a letter to the Associate Editors that machine learning has been one of the most significant innovations in engineering. He had determined that in 2014 about 20% of the contributions to TMI included machine learning topics, and in 2017 that had increased to more than 75%.

Within machine learning, deep learning has become the leading methodology for image analysis. For all papers published in TMI before 2016, the term "deep learning" returns three hits using a Google Scholar search. For 2016 there are 36 hits, for 15% of the published papers. For 2017 and 2018, this increases to 19% and 32%. Likewise, at the moment of writing, 11 of the 23 papers listed on the website of Medical Image Analysis as "Most downloaded in the last 90 days" are about deep learning; of the 25 papers listed as "Most cited since 2013" there are three papers from 2017, all on deep learning, and there are no other papers listed that were published after 2015.

Clearly, deep learning is taking medical imaging by storm. Although major conferences in our field are devoting space to this topic, we felt it was time to organize a new conference, exclusively focused on this topic. We have opted for a modern open publishing model, inspired by the success of ICLR. Reviews and papers are all publicly available on [openreview.net](https://openreview.net) and considered non-archival.

When we started making arrangements, in early November, we had discussions on contingency plans for when we would not receive enough submissions. In hindsight, that discussion was unnecessary. However, even in our highest estimates we never expected over 200 submissions for the inaugural edition of MIDL. We received 112 full conference papers and 99 abstracts. We accepted 47 full papers and 35 abstracts, which means acceptance rates of 41% and 35% for the two tracks respectively. We felt we had to reject many papers and abstracts with merit.

The number of registrations also exceeded our expectations. Initially, we estimated a maximum of 250 attendees. However, after author registration, all our remaining slots were filled within hours, and we had to add people to the waiting list even before our early-bird discount expired. After discussion with our venue, we managed to scale up to 290 attendees but still had to disappoint many people.

The high interest for MIDL also extended to industry, and we attracted many sponsors willing to support the conference. We would like to thank all of them for their contributions.

We hope for a successful first edition of MIDL and we expect that this will be the start of a long series of high-quality meetings where academics, clinicians, and industry meet and exchange ideas across the field of medical imaging and deep learning.



*Bram van Ginneken  
Max Welling  
MIDL Conference Chairs*



*Clarisa Sanchez  
Geert Litjens  
Ivana Išgum  
MIDL Program Chairs*

## KEYNOTE SPEAKERS

Wednesday at 9AM

**Dr. Graham Taylor, Associate Professor at the University of Guelph**



### **Efficient techniques for learning confidence**

Modern neural networks are very powerful predictive models, but they are often incapable of recognizing when their predictions may be wrong. I will discuss a method of learning confidence estimates for neural networks that is simple to implement, computationally efficient and produces intuitively interpretable outputs. I will demonstrate that on the task of out-of-distribution detection, our technique surpasses recently proposed techniques which construct confidence based on the network's output distribution, without requiring any additional labels or access to out-of-distribution examples. I will also show that it can generate per-pixel confidence maps and image-level prediction of failure in medical image segmentation.

### **Biography**

Graham Taylor is an Associate Professor of Engineering at the University of Guelph, a CIFAR Azrieli Global Scholar, an Academic Director of NextAI, and a member at the Vector Institute for Artificial Intelligence. His research aims to discover new algorithms and architectures for deep learning: the automatic construction of hierarchical algorithms from high-dimensional, unstructured data. He is especially interested in time series, having applied his work to better understand human and animal behavior, environmental data (climate or agricultural), audio (music or speech) and medical informatics. His work also intersects high performance computing, investigating better ways to leverage hardware accelerators to cope with the challenges of large-scale machine learning. He co-organizes the annual CIFAR Deep Learning Summer School, and has trained more than 50 students and staff members on AI-related projects.

Wednesday at 2PM

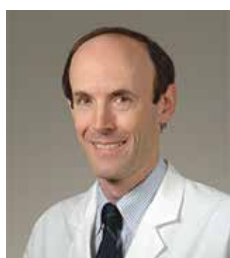
**Prof. Ronald Summers, Senior Investigator and Staff Radiologist at the NIH**

### **The Impact of Deep Learning and Artificial Intelligence on Radiology**

Major advances in computer science and artificial intelligence, in particular "deep learning", are beginning to have an impact on radiology. There has been an explosion of research interest and number of publications about the use of deep learning in radiology. In this presentation, I will show examples of how deep learning has led to major improvements in automated radiology image analysis, especially for image segmentation and computer aided diagnosis. I will also show how the radiology report can be used to do bulk annotation of images for training the deep learning systems.

### **Biography**

Ronald M. Summers received the B.A. degree in physics and the M.D. and Ph.D. degrees in Medicine/Anatomy & Cell Biology from the University of Pennsylvania. In 1994, he joined the Diagnostic Radiology Department at the NIH Clinical Center in Bethesda, MD where he is now a tenured Senior Investigator and Staff Radiologist. In 2013, he was named a Fellow of the Society of Abdominal Radiologists. He is currently Chief of the Clinical Image Processing Service and directs the Imaging Biomarkers and Computer-Aided Diagnosis (CAD) Laboratory. In 2000, he received the Presidential Early Career Award for Scientists and Engineers, presented by Dr. Neal Lane, President Clinton's science advisor. In 2012, he received the NIH Director's Award, presented by NIH Director Dr. Francis Collins. His research interests include deep learning, virtual colonoscopy, CAD and development of large radiologic image databases. His clinical areas of specialty are thoracic and abdominal radiology and body cross-sectional imaging. He is a member of the editorial boards of the Journal of Medical Imaging and Academic Radiology and a past member of the editorial board of Radiology. He is a program committee member of the Computer-aided Diagnosis section of the annual SPIE Medical Imaging conference and will be co-chair of the entire conference in 2018 and 2019.



**Thursday at 9AM**

**Dr. Adriana Romero, Research Scientist at Facebook AI Research**

#### **Deep learning for genomics and graph-structured data**

In the recent years, deep learning has achieved promising results in medical imaging analysis. However, in order to fully exploit the richness of healthcare data, new models able to deal with a variety of modalities have to be designed. In this talk, I will discuss recent advances in deep learning for genomics and graph-structured data. I will present Diet Networks, a recent contribution which copes with the high dimensionality of genomic data. Then, I will introduce our work on Graph Attention Networks, which has recently shown to improve results on protein-protein interaction networks and mesh-based parcellation of the cerebral cortex.



#### **Biography**

Adriana Romero is a research scientist at Facebook AI Research and an adjunct professor at McGill University. Previously, she was a post-doctoral researcher at Montreal Institute for Learning algorithms, advised by Prof. Yoshua Bengio. Her research revolves around deep learning techniques to tackle biomedical data analysis challenges, addressing impactful problems for society by paving the road towards enabling widespread usage of personalized medicine. Adriana received her Ph.D. from the University of Barcelona in 2015 with a thesis on assisting the training of deep neural networks with applications to computer vision, advised by Dr. Carlo Gatta. Her PhD included contributions in the fields of representation learning and model compression, with applications to image classification, image segmentation and remote sensing.

**Thursday at 2PM**

**Dr. Tim Salimans, Research Scientist at OpenAI and Scientific Advisor and Co-Founder at Aidence**

#### **Detecting Lung Nodules using Deep Learning**

Lung cancer is the leading cause of cancer-related death worldwide. By screening high risk individuals for lung nodules using low-dose CT scans, this type of cancer can be detected when it is still treatable. However, large-scale implementation of such screening programs requires radiologists to evaluate a huge number of scans, which is costly and error-prone. Aidence is an Amsterdam start-up developing an AI assistant for helping radiologists with detecting, reporting and tracking of lung nodules. This talk covers the deep learning techniques that we use to obtain state of the art accuracy in this domain, as well as the requirements and challenges faced when developing a deep learning system for use in clinical practice.

#### **Biography**

Tim Salimans is a Machine Learning research scientist working on generative modeling, semi-supervised and unsupervised deep learning, and reinforcement learning. He received his PhD from Erasmus University Rotterdam. He is most well known for his work on GANs and VAEs. He received the 2014 Lindley prize for his work in variational inference using reparameterization and he is the winner of multiple Kaggle competitions. At MIDL he will be speaking about his work with Aidence, the Amsterdam startup that's building a Deep Learning software platform to help radiologists improve their diagnostic accuracy and reading efficiency.



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## WEDNESDAY ORAL SESSION

### NOVEL EXTENSIONS TO CONVOLUTIONAL NETWORKS (1)

*Session Chairs:* Hans Meine, Fraunhofer MEVIS, Bremen (Germany) and Nasir M. Rajpoot, The University of Warwick (UK)

**9:40 Cancer Metastasis Detection With Neural Conditional Random Field**

Yi Li, Wei Ping  
Baidu Silicon Valley Artificial Intelligence Lab, US

**10:00 Automated Segmentation of Knee Bone and Cartilage combining Statistical Shape Knowledge and Convolutional Neural Networks: Data from the Osteoarthritis Initiative**

Felix Ambellan, Alexander Tack, Moritz Ehlke, Stefan Zachow  
Zuse Institute Berlin, Germany

**10:20 Robust training of recurrent neural networks to handle missing data for disease progression modeling**

Mostafa Mehdipour Ghazi, Mads Nielsen, Akshay Pai, M. Jorge Cardoso, Marc Modat, Sebastien Ourselin, Lauge Sørensen  
Biomediq A/S, Denmark

### ALTERNATIVE DL ARCHITECTURES

*Session Chairs:* Ender Konukoglu, ETH-Zurich (Switzerland) and Olaf Ronneberger, DeepMind, London (UK)

**11:10 OBELISK – One Kernel to Solve Nearly Everything: Unified 3D Binary Convolutions for Image Analysis**

Mattias P. Heinrich, Ozan Oktay, Nassim Bouteldja  
University of Lübeck, Germany

**11:30 3D G-CNNs for Pulmonary Nodule Detection**

Marysia Winkels, Taco S. Cohen  
University of Amsterdam/Aidence, the Netherlands

**11:50 Capsules for Object Segmentation**

Rodney LaLonde, Ulas Bagci  
University of Central Florida, US

**12:10 Convolutional neural networks for mesh-based parcellation of the cerebral cortex**

Guillem Cucurull, Konrad Wagstyl, Arantxa Casanova, Petar Veličković, Estrid Jakobsen  
Michal Drozdal, Adriana Romero, Alan Evans, Yoshua Bengio  
Montreal Institute for Learning Algorithms, Canada



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## About HeartFlow

HeartFlow is a medical technology company transforming the way heart disease is diagnosed and treated with the non-invasive HeartFlow Analysis. Our technology is reflective of our Silicon Valley roots and incorporates decades of scientific evidence with the latest advances in artificial intelligence. HeartFlow has offices in the United States, Europe and Japan.

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## WEDNESDAY POSTER SESSION

### PAPERS

#### **Histopathology Stain-Color Normalization Using Generative Neural Networks**

Farhad G. Zanjani, Svitlana Zinger, Peter H.N. de With, Babak E. Bejnordi, Jeroen A.W.M. van der Laak  
Eindhoven University of Technology, the Netherlands

#### **Unsupervised Detection of Lesions in Brain MRI using constrained adversarial auto-encoders**

Xiaoran Chen, Ender Konukoglu  
ETH Zurich, Switzerland

#### **NeuroNet: Fast and Robust Reproduction of Multiple Brain Image Segmentation Pipelines**

Martin Rajchl, Nick Pawlowski, Daniel Rueckert, Paul M. Matthews, Ben Glocker  
Imperial College London, UK

#### **Convolutional Neural Networks for Lymphocyte detection in Immunohistochemically Stained Whole-Slide Images**

Zaneta Swiderska-Chadaj, Hans Pinckaers, Mart van Rijthoven, Maschenka Balkenhol, Margarita Melnikova, Oscar Geessink, Quirine Manson, Geert Litjens, Jeroen van der Laak, Francesco Ciompi  
Radboud University Medical Center, the Netherlands

#### **Blood Vessel Geometry Synthesis using Generative Adversarial Networks**

Jelmer M. Wolterink, Tim Leiner, Ivana Išgum  
University Medical Center Utrecht, the Netherlands

#### **Brain MRI super-resolution using 3D generative adversarial networks**

Irina Sánchez, Verónica Vilaplana  
Universitat Politècnica de Catalunya, Spain

#### **RadBot-CXR: Classification of Four Clinical Finding Categories in Chest X-Ray Using Deep Learning**

Chen Brestel, Ran Shadmi, Itamar Tamir, Michal Cohen-Sfaty, Eldad Elnekave  
Zebra Medical Vision, Israel

### ABSTRACTS

#### **A deep multiple instance model to predict prostate cancer metastasis from nuclear morphology**

Nathan Ing, Beatrice S. Knudsen, Arkadiusz Gertych, Jakub M. Tomczak, Max Welling  
Cedars-Sinai Medical Center, US

#### **Extraction of Airways using Graph Neural Networks**

Raghavendra Selvan, Thomas Kipf, Max Welling, Jesper H. Pedersen, Jens Petersen, Marleen de Bruijne  
University of Copenhagen, Denmark

#### **Subject-level Prediction of Segmentation Failure using Real-Time Convolutional Neural Nets**

Robert Robinson, Ozan Oktay, Wenjia Bai, Vanya V. Valindria, Mihir M. Sanghvi, Nay Aung, José Miguel Paiva, Filip Zemrak, Kenneth Fung, Elena Lukaschuk, Aaron M. Lee, Valentina Carapella, Young Jin Kimm, Bernhard Kainz, Stefan K. Piechnik, Stefan Neubauer, Steffen E. Petersen, Chris Page, Daniel Rueckert, Ben Glocker  
Imperial College London, UK

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### **Using Three-Dimensional Cardiac Motion for Predicting Mortality in Pulmonary Hypertension: A Deep Learning Approach**

Ghalib A. Bello, Timothy J.W. Dawes, Jinming Duan, Declan P. O'Regan  
Imperial College London, UK

### **Automatic Shadow Detection in 2D Ultrasound**

Qingjie Meng, Christian Baumgartner, Matthew Sinclair, James Housden, Martin Rajchl, Alberto Gomez, Benjamin Hou, Nicolas Toussaint, Jeremy Tan, Jacqueline Matthew, Daniel Rueckert, Julia Schnabel, Bernhard Kainz  
Imperial College London, UK

### **Iteratively unveiling new regions of interest in Deep Learning models**

Florian Bordes, Tess Berthier, Lisa Di Jorio, Pascal Vincent, Yoshua Bengio  
Université de Montréal, Canada

### **Contextual Hourglass Networks for Segmentation and Density Estimation**

Daniel Oñoro-Rubio, Mathias Niepert  
NEC Labs Europe, Germany

### **TOMAAT: volumetric medical image analysis as a cloud service**

Fausto Milletari, Johann Frei, Seyed-Ahmad Ahmadi  
NVIDIA, United States

### **Stereology as Weak Supervision for Medical Image Segmentation**

Giorgia Silvestri, Luca Antiga  
Orobix Srl, Italy

### **Unsupervised Prostate Cancer Detection on H&E using Convolutional Adversarial Autoencoders**

Wouter Bulten, Geert Litjens  
Radboud University Medical Center, the Netherlands

### **Lung nodule segmentation with convolutional neural network trained by simple diameter information**

Chang-Mo Nam, Jihang Kim, Kyong Joon Lee  
Seoul National University Bundang Hospital, Republic of Korea

### **An ensemble of 3D convolutional neural networks for central vein detection in white matter lesions**

Mário João Fartaria, Jonas Richiardi, João Jorge, Pietro Maggi, Pascal Sati, Daniel S. Reich, Reto Meuli, Cristina Granziera, Meritxell Bach Cuadra, Tobias Kober  
ACIT SIEMENS, Switzerland

### **Learning-based solution to phase error correction in T2\*-weighted GRE scans**

Alexander Loktyushin, Philipp Ehses, Bernhard Schölkopf, Klaus Scheffler  
MPI for Biological Cybernetics, Germany

### **Improved Semantic Segmentation for Histopathology using Rotation Equivariant Convolutional Networks**

Jim Winkens, Jasper Linmans, Bastiaan S. Veeling, Taco S. Cohen, Max Welling  
University of Amsterdam, the Netherlands



## RECEPTION AND WELCOME DINNER



### LOCATION

The welcome reception and dinner of the inaugural edition of MIDL will take place at the **Royal Tropical Institute**. It is situated in a historical building featuring many beautiful, elegant rooms. It is an independent center of expertise, education and inter-cultural cooperation, dedicated to sustainable development.

### PROGRAM

- 18.00 Free guided tours at the Tropenmuseum
- 19.00 Start of the Reception and Welcome Dinner in the Inner Garden of the Royal Tropical Institute
- 22.30 End of the Reception and Welcome Dinner

### GUIDED TOURS AT THE TROPENMUSEUM

As an attendee of MIDL you have the option to join a free guided tour at the Tropenmuseum, located at the Royal Tropical Institute.

The museum is housed in one of the most impressive museum buildings in the Netherlands. From the monumental Great Hall there is a wide view of what the museum has to offer. The extensive permanent display and regularly changing exhibitions feature objects that all have a story to tell about humankind. Stories about universal human themes like mourning, celebration, ornamentation, prayer, and conflict.

During your visit of the Tropenmuseum you will discover that, despite cultural differences, we are all essentially the same. We will be

only visitors of the museum, so this is a great opportunity to get in-depth information on all the exhibits.



*Two current exhibits at the Tropenmuseum: Afrofuturism and Fashion Cities of Africa*

## RECEPTION AND WELCOME DINNER

The dinner will take place in the Inner Garden ('binnentuin') of the Royal Tropical Institute. In case of bad weather, the dinner will be hosted inside in the Marble Hall. The Reception and Welcome Dinner will be in the form of a walking dinner ('standing buffet') with eight courses of smaller dishes, which together will constitute a full meal. Servers will bring out the courses one at a time, for each attendee one plate for each course is available, so please do not take multiple plates. Drinks such as water, soda, beer and wine are included. In case you indicated any dietary restrictions, please notify the servers such that you will receive appropriate replacement dishes when necessary.

## OTHER INFORMATION AND HOW TO GET THERE

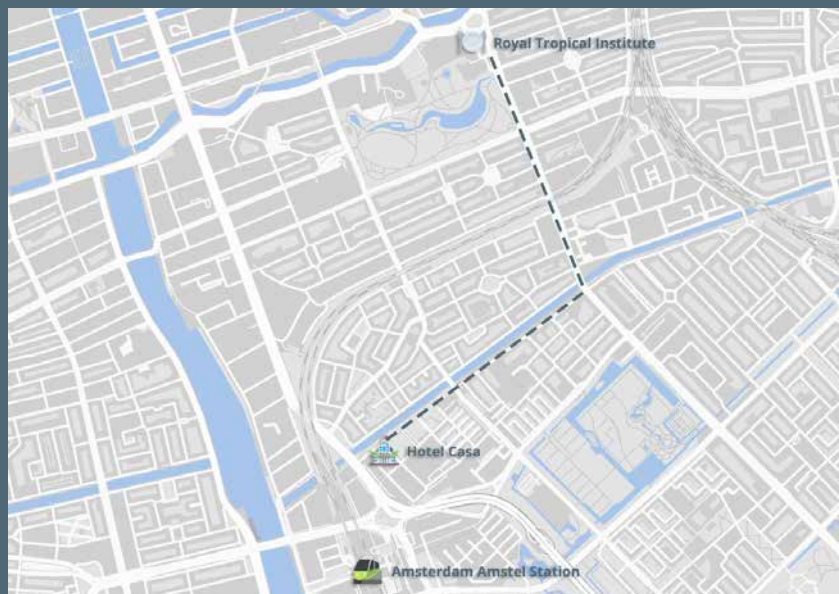
The websites of the Tropenmuseum and the Royal Tropical Institute are:

<https://www.tropenmuseum.nl/en>  
[www.kit.nl/en/](http://www.kit.nl/en/)

And the address is:

**Linnaeusstraat 2,  
1092 CK, Amsterdam**

From the conference venue (Hotel Casa) it is an easy 2km walk along the water which should take you less than half an hour. The route is indicated in the map below. You can also arrange taxi transportation or rental bikes at the reception of Hotel Casa.





# Pie Medical Imaging

## Software solutions in cardiovascular imaging

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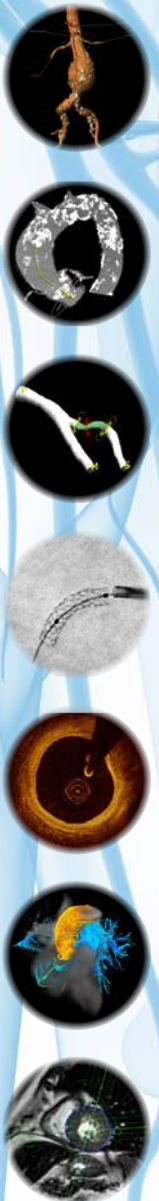
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## THURSDAY ORAL SESSION

### NOVEL EXTENSIONS TO CONVOLUTIONAL NETWORKS (2)

*Session Chairs:* Hayit Greenspan, Tel Aviv University (Israel) and Mitko Veta, Eindhoven University of Technology (the Netherlands)

**9:40 MILD-Net: Minimal Information Loss Dilated Network for Gland Instance Segmentation in Colon Histology Images**

Simon Graham, Hao Chen, Qi Dou, Pheng Ann-Heng, Nasir Rajpoot  
University of Warwick, UK

**10:00 Attention U-Net: Learning Where to Look for the Pancreas**

Ozan Oktay, Jo Schlemper, Loic Le Folgoc, Matthew Lee, Mattias Heinrich, Kazunari Misawa, Kensaku Mori, Steven McDonagh, Nils Y. Hammerla, Bernhard Kainz, Ben Glocker, Daniel Rueckert  
Imperial College London, UK

**10:20 Iterative fully convolutional neural networks for automatic vertebra segmentation**

Nikolas Lessmann, Bram van Ginneken, Pim A. de Jong, Ivana Isgum  
University Medical Center Utrecht, the Netherlands

### MEDICAL IMAGE ENHANCEMENT, GENERATION AND RECONSTRUCTION

*Session Chairs:* Michal Drożdżal, Facebook AI Research, Montreal (Canada) and Holger Roth, NVIDIA, Bethesda, MD (USA)

**11:10 Adversarial training with cycle consistency for unsupervised super-resolution in endomicroscopy**

Daniele Ravi, Agnieszka Barbara Szczotka, Dzhoshkun Ismail Shakir, Stephen P Pereira, Tom Vercauteren  
University College London, UK

**11:30 Temporal Interpolation via Motion Field Prediction**

Lin Zhang, Neerav Karani, Christine Tanner, Ender Konukoglu  
ETH Zurich, Switzerland

**11:50 Stacked Bidirectional Convolutional LSTMs for 3D Non-contrast CT Reconstruction from Spatiotemporal 4D CT**

Sil C. van de Leemput, Mathias Prokop, Bram van Ginneken, Rashindra Manniesing, Radboud University Medical Center, the Netherlands

**12:10 Recurrent Inference Machines for Accelerated MRI Reconstruction**

Kai Lønning, Patrick Putzky, Matthan Caan, Max Welling  
University of Amsterdam, the Netherlands

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## THURSDAY POSTER SESSION

### PAPERS

**One-class Gaussian process regressor for quality assessment of transperineal ultrasound images**

Saskia M. Camps, Tim Houben, Davide Fontanarosa, Christopher Edwards, Maria Antico, Matteo Dunnhofer, Esther G.H.J. Martens, Jose A. Baeza, Ben G.L. Vanneste, Evert J. van Limbergen, Peter H.N. de With, Frank Verhaegen, Gustavo Carneiro  
Eindhoven University of Technology, the Netherlands

**Unsupervised Deformable Image Registration with Fully Connected Generative Neural Network**

Ameneh Sheikhsafari, Kumaradevan Punithakumar, Nilanjan Ray  
University of Alberta, Canada

**Uncertainty-driven Sanity Check: Application to Postoperative Brain Tumor Cavity Segmentation**

Alain Jungo, Raphael Meier, Ekin Ermis, Evelyn Herrman, Mauricio Reyes  
University of Bern, Switzerland

**Automatic multi-organ segmentation in dual energy CT using 3D fully convolutional network**

Shuqing Chen, Xia Zhong, Shiyang Hu, Sabrina Dorn, Marc Kachelrieß, Michael Lell, Andreas Maier  
Friedrich-Alexander-Universität, Germany

**DeepSDCS: Dissecting cancer proliferation heterogeneity in Ki67 digital whole slide images**

Priya Lakshmi Narayanan, Andrew Dodson, Barry Guesterson, Mitchell Dowsett, Yinyin Yuan  
Institute of Cancer Research, UK

**Automatic catheter detection in pediatric X-ray images using a scale-recurrent network and synthetic data**

Xin Yi, Scott Adams, Paul Babyn, Abdul Elnajmi  
University of Saskatchewan, Canada

**CNN-based Landmark Detection in Cardiac CTA Scans**

Julia M.H. Noothout, Bob D. de Vos, Jelmer M. Wolterink, Tim Leiner, Ivana Išgum  
University Medical Center Utrecht, the Netherlands

**Retrospective correction of motion artifact affected structural MRI images using deep learning of simulated motion**

Ben A. Duffy, Wenlu Zhang, Haoteng Tang, Lu Zhao, Meng Law, Arthur W. Toga, Hosung Kim  
USC Stevens Neuroimaging and Informatics Institute, US

### ABSTRACTS

**A Deep Learning Framework for Automatic Diagnosis in Lung Cancer**

Nikolay Burlutskiy, Feng Gu, Lena Kajland Wilen, Max Backman, Patrick Micke  
ContextVision AB, Sweden

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**Deep Pose Estimation for Image-Based Registration**

Benjamin Hou, Nina Miolane, Bishesh Khanal, Matthew C.H. Lee, Amir Alansary, Steven McDonagh, Joseph Hajnal, Daniel Rueckert, Ben Glocker, Bernhard Kainz  
Imperial College London, UK

**Image-Based Registration in Canonical Atlas Space**

Benjamin Hou, Bishesh Khanal, Amir Alansary, Steven McDonagh, Alice Davidson, Mary Rutherford, Jo V. Hajnal, Daniel Rueckert, Ben Glocker, Bernhard Kainz  
Imperial College London, UK

**Standard Plane Localisation in 3D Fetal Ultrasound Using Network with Geometric and Image Loss**

Yuanwei Li, Juan J. Cerrolaza, Matthew Sinclair, Benjamin Hou, Amir Alansary, Bishesh Khanal, Jacqueline Matthew, Bernhard Kainz, Daniel Rueckert  
Imperial College London, UK

**Deep Learning Methods for Estimating “Brain Age” from Structural MRI Scans**

Sebastian G. Popescu, James H. Cole, Ben Glocker, David J. Sharp  
Imperial College London, UK

**Compact feature representations for human brain cytoarchitecture using self-supervised learning**

Hannah Spitzer, Katrin Amunts, Stefan Harmeling, Timo Dickscheid  
Research Center Jülich, Germany

**How to Cure Cancer (in images) with Unpaired Image Translation**

Joseph Paul Cohen, Margaux Luck, Sina Honari  
University of Montreal, Canada

**You Only Look on Lymphocytes Once**

Mart van Rijthoven, Zaneta Swiderska-Chadaj, Katja Seeliger, Jeroen van der Laak, Francesco Ciompi  
Radboud University Medical Center, the Netherlands

**Improving weakly-supervised lesion localization with iterative saliency map refinement**

Cristina González-Gonzalo, Bart Liefers, Bram van Ginneken, Clara I. Sánchez  
Radboud University Medical Center, the Netherlands

**Quality control in radiotherapy-treatment planning using multi-task learning and uncertainty estimation**

Felix J.S. Bragman, Ryutaro Tanno, Zach Eaton-Rosen, Wenqi Li, David J. Hawkes, Sébastien Ourselin, Daniel C. Alexander, Jamie R. McClelland, M. Jorge Cardoso  
University College London, UK

**Monte-Carlo Sampling applied to Multiple Instance Learning for Whole Slide Image Classification**

Marc Combalia, Verónica Vilaplana  
Universitat Politècnica de Catalunya, Barcelona, Spain

**Data-efficient Convolutional Neural Networks for Treatment Decision Support in Acute Ischemic Stroke**

Adam Hilbert, Bastiaan S. Veeling, Henk A. Marquering  
University of Amsterdam, the Netherlands



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## FRIDAY ORAL SESSION

### UNCERTAINTY ESTIMATION AND REINFORCEMENT LEARNING IN MEDICAL IMAGING

*Session Chairs:* Marleen de Bruijne, ErasmusMC, Rotterdam (the Netherlands) and Jelmer Wolterink, UMCU, Utrecht (the Netherlands)

- 9:00 Evaluating Reinforcement Learning Agents for Anatomical Landmark Detection**  
Amir Alansary, Ozan Oktay, Yuanwei Li, Loic Le Folgoc, Benjamin Hou, Ghislain Vaillant, Ben Glocker, Bernhard Kainz, Daniel Rueckert  
Imperial College London, UK
- 09:20 Uncertainty quantification using Bayesian neural networks in classification: Application to ischemic stroke lesion segmentation**  
Yongchan Kwon, Joong-Ho Won, Beom Joon Kim, Myunghee Cho Paik  
Seoul National University, Korea
- 09:40 Test-time Data Augmentation for Estimation of Heteroscedastic Aleatoric Uncertainty in Deep Neural Networks**  
Murat Seçkin Ayhan, Philipp Berens  
University of Tübingen, Germany

### WEAKLY SUPERVISED AND UNSUPERVISED LEARNING IN MEDICAL IMAGING

*Session Chairs:* Colin Jacobs, Radboud UMC, Nijmegen (the Netherlands) and Michiel Schaap, Heartflow, Redwood City, CA (USA)

- 13:30 Deep Multi-Class Segmentation Without Ground-Truth Labels**  
Thomas Joyce, Agisilaos Chartsias, Sotirios A. Tsaftaris  
University of Edinburgh, UK
- 13:50 Size-constraint loss for weakly supervised CNN segmentation**  
Hoel Kervadec, Jose Dolz, Meng Tang, Éric Granger, Yuri Boykov, Ismail Ben Ayed  
ÉTS Montréal, Canada
- 14:10 Weakly Supervised Learning for Whole Slide Lung Cancer Image Classification**  
Xi Wang, Hao Chen, Caixia Gan, Huangjing Lin, Qi Dou, Qitao Huang, Muyan Cai, Pheng-Ann Heng  
The Chinese University of Hong Kong, China
- 14:30 Regularized siamese neural network for unsupervised outlier detection on brain multiparametric magnetic resonance imaging: application to epilepsy lesion screening**  
Zara Alaverdyan, Julien Jung, Romain Bouet, Carole Lartizien  
University Lyon, France

An abstract graphic in shades of green and blue. It features a grid of medical images (X-rays, CT scans) on the left, a series of overlapping translucent planes in the center, and a 3D structure of cubes on the right, some of which are filled with data points or patterns, suggesting AI processing and data analysis.

## NVIDIA IN HEALTHCARE DRIVING AI ADVANCES IN MEDICINE AND RESEARCH

Deep learning is the fastest growing field in artificial intelligence (AI), helping computers understand huge data sets of images, sound, and text. Using deep neural networks, computers now can see, learn, and react to complex situations. This is leading to a profoundly different way of thinking about your data, your technology, and the products and services you deliver.

### DEEP LEARNING IN HEALTHCARE

#### Genomics for personalized medicine.

Genomics data is accumulating in unprecedented quantities, giving scientists the ability to study how genetic factors like mutations lead to disease, closing the gap between our genotype and phenotype. Deep learning could lead to treatments tailored to a patient's genomic makeup.

#### Higher accuracy medical imaging for better, faster diagnoses.

Medical images like pathology slides, MRIs, CT scans, and X-rays are some of the most important tools used when diagnosing conditions, from spine injuries to heart disease to cancer. However, analyzing medical images is a difficult and time-consuming process. Researchers, startups, and enterprises are using GPU-accelerated deep learning to automate image analysis and increase the accuracy of diagnosticians.

#### Mining medical data for more accurate, quicker treatment.

Electronic health records (EHRs) contain a gold mine of health information like doctors' reports, test results, and medical images. GPU-accelerated deep learning can process and study a patient's condition over time. Then, compare one patient against a larger population to come up with the best treatment plan.

#### Faster drug development.

Developing new drugs to treat diseases is the focus of the world's finest researchers. It's also something that's cost and time prohibitive – new drugs can take years and cost billions of dollars to bring to market. To help with this, experts are using GPU-accelerated chemical modeling algorithms to help accelerate drug discovery and refine the development process.

For more information, visit [www.nvidia.co.uk/deep-learning-ai/industries/healthcare/](http://www.nvidia.co.uk/deep-learning-ai/industries/healthcare/)

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## FRIDAY POSTER SESSION

### PAPERS

#### **Cascaded Transforming Multi-task Networks For Abdominal Biometric Estimation from Ultrasound**

Matthew D. Sinclair, Juan Cerrolaza Martinez, Emily Skelton, Yuanwei Li, Christian F. Baumgartner, Wenjia Bai, Jacqueline Matthew, Caroline L. Knight, Sandra Smith, Jo Hajnal, Andrew P. King, Bernhard Kainz, Daniel Rueckert  
Imperial College London, UK

#### **Attention-Gated Networks for Improving Ultrasound Scan Plane Detection**

Jo Schlemper, Ozan Oktay, Liang Chen, Jacqueline Matthew, Caroline Knight, Bernhard Kainz, Ben Glocker, Daniel Rueckert  
Imperial College London, UK

#### **Domain Adaptation for MRI Organ Segmentation using Reverse Classification Accuracy**

Vanya V. Valindria, Ioannis Lavdas, Wenjia Bai, Konstantinos Kamnitsas, Eric O. Aboagye, Andrea G. Rockall, Daniel Rueckert, Ben Glocker  
Imperial College London, UK

#### **Generative Adversarial Training for MRA Image Synthesis Using Multi-Contrast MRI**

Sahin Olut, Yusuf H. Sahin, Ugur Demir, Gozde Unal  
Istanbul Technical University, Turkey

#### **Towards Deep Cellular Phenotyping in Placental Histology**

Michael Ferlaino, Craig A. Glastonbury, Carolina Motta-Mejia, Manu Vatish, Ingrid Granne, Stephen Kennedy, Cecilia M. Lindgren, Christoffer Nellåker  
University of Oxford, UK

#### **Motion Estimation in Coronary CT Angiography Images using Convolutional Neural Networks**

Tanja Elss, Hannes Nickisch, Tobias Wissel, Rolf Bippus, Michael Morlock, Michael Grass  
Philips Research Hamburg, Germany

#### **Predicting Lesion Growth and Patient Survival in Colorectal Cancer Patients using Deep Neural Networks**

Alexander Katzmann, Alexander Mühlberg, Michael Sühling, Dominik Nörenberg, Julian Walter Holch, Volker Heinemann, Horst-Michael Groß  
Siemens Healthcare GmbH, Germany

#### **MURA Dataset: Towards Radiologist-Level Abnormality Detection in Musculoskeletal Radiographs**

Pranav Rajpurkar, Jeremy Irvin, Aarti Bagul, Daisy Ding, Tony Duan, Hershel Mehta, Brandon Yang, Kaylie Zhu, Dillon Laird, Robyn L. Ball, Curtis Langlotz, Katie Shpanskaya, Matthew P. Lungren, Andrew Y. Ng  
Stanford University, US

#### **Simultaneous synthesis of FLAIR and segmentation of white matter hypointensities from T1 MRIs**

M. Orbes-Arteaga, Akshay Pai, Lauge Sørensen, Marc Modat, M. Jorge Cardoso, Sébastien Ourselin, Mads Nielsen  
University College London, UK

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## **Predictive Image Regression for Longitudinal Studies with Missing Data**

Sharmin Pathan, Yi Hong  
University of Georgia, US

## **Automatic Detection and Characterization of Coronary Artery Plaque and Stenosis using a Recurrent Convolutional Neural Network in Coronary CT Angiography**

Majd Zreik, Robbert W. van Hamersvelt, Jelmer M. Wolterink, Tim Leiner, Max A. Viergever, Ivana Išgum  
University Medical Center Utrecht, the Netherlands

## ABSTRACTS

### **Roto-Translation Covariant Convolutional Networks for Medical Image Analysis**

Erik J. Bekkers, Maxime W. Lafarge, Mitko Veta, Koen A.J. Eppenhof, Josien P.W. Pluim, Remco Duits  
Eindhoven University of Technology, the Netherlands

### **Adversarial Training for Patient-Independent Feature Learning with IVOCT Data for Plaque Classification**

Nils Gessert, Markus Heyder, Sarah Latus, David M. Leistner, Youssef S. Abdelwahed, Matthias Lutz, Alexander Schlaefer  
Hamburg University of Technology, Germany

### **Unsupervised Lesion Detection in Brain CT using Bayesian Convolutional Autoencoders**

Nick Pawlowski, Matthew C.H. Lee, Martin Rajchl, Steven McDonagh, Enzo Ferrante, Konstantinos Kamnitsas, Sam Cooke, Susan Stevenson, Aneesh Khetani, Tom Newman, Fred Zeiler, Richard Digby, Jonathan P. Coles, Daniel Rueckert, David K. Menon, Virginia F.J. Newcombe, Ben Glocker  
Imperial College London, UK

### **Comparison of deep learning-based techniques for organ segmentation in abdominal CT images**

V. Groza, T. Brosch, D. Eschweiler, H. Schulz, S. Renisch, H. Nickisch  
Philips Innovation Labs RUS, Russia

### **Gigapixel Whole-Slide Image Classification Using Unsupervised Image Compression And Contrastive Training**

David Tellez, Jeroen van der Laak, Francesco Ciompi  
Radboud University Medical Center, the Netherlands

### **Training convolutional neural networks with megapixel images**

J.H.F.M. Pinckaers, G.J.S Litjens  
Radboud University Medical Center, the Netherlands

### **Diagnosis of Maxillary Sinusitis on Waters' View Conventional Radiograph using Convolutional Neural Network**

Youngjune Kim, Kyong Joon Lee, Leonard Sunwoo, Dongjun Choi, Chang-Mo Nam, Jung Hyun Park  
Seoul National University Bundang Hospital, Republic of Korea

### **Improving Data Augmentation for Medical Image Segmentation**

Zach Eaton-Rosen, Felix Bragman, Sebastien Ourselin, M. Jorge Cardoso  
University College London, UK

### **Histopathological classification of precursor lesions of esophageal adenocarcinoma: A Deep Multiple Instance Learning Approach**

Jakub M. Tomczak, Maximilian Ilse, Max Welling, Marnix Jansen, Helen G. Coleman, Marit Lucas, Kikki de Laat, Martijn de Bruin, Henk Marquering, Myrtle J. van der Wel, Onno J. de Boer, C. Dilara Savci Heijink, Sybren L. Meijer  
University of Amsterdam, the Netherlands



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## PANEL DISCUSSION



### SETUP

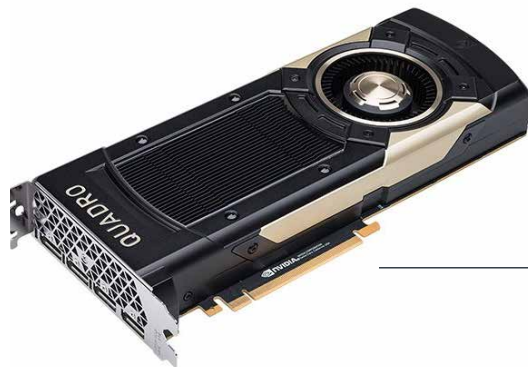
On Friday at 11.30h we will have a panel discussion with members from healthcare, industry and academia. These experts will share their vision and discuss perspectives for the application of deep learning to medical imaging. The conference organizers will prepare a set of topics for the panelist.

### PARTICIPATE

We also want to give you, the attendees, the possibility to participate. If you have a topic you would like to have discussed, please send an e-mail with your question or statement to [panel@midl.amsterdam](mailto:panel@midl.amsterdam). Please also include a motivation on why your topic is important, which will increase the likelihood of it being selected. No topics are off limits. Questions from the audience during the panel discussion are also welcome.

### PANEL COMPOSITION

We understand that panel composition may play a role in which topics you would like to have addressed. At the time of printing of this conference book this was not yet finalized, but if you are curious, please check the MIDL website to find a list of panelists.



## AWARDS

Thanks to our sponsors we are able to present several awards to the participants of the MIDL conference. We have the quintessential 'best paper' and 'best poster' awards, made possible by NVIDIA, which allows us to highlight the best work submitted to MIDL this year. In addition, we have two 'impact' awards made possible by Philips for work that has a high chance of making the transition from research to society. As we are trying to bridge the gap between clinical, medical imaging and machine learning research and industry we are especially happy that we can offer the Impact award, as it exemplifies this commitment. Last, we kindly thank CIFAR for providing us with the means to allow talented students and students from underrepresented groups and lower-income countries to join us at MIDL. In the name of transparency we would also like to detail the judging process for each of these awards. You can find those details below.



### BEST PAPER AND POSTER

The NVIDIA 'Best paper' and 'Best poster' awards recognize the highest quality paper and poster presented at the MIDL conference. The two awards consist of one NVIDIA Quadro GV100 and one NVIDIA 1080Ti GPU, which have a monetary value of 10000 American dollars. All papers and posters presented at MIDL are eligible. For these awards two separate committees of PC members will rank all papers and posters with an average review score above 3.5. For the paper awards the judgement will be based solely on the paper. For the poster award the judgement will be based on the poster discussion as well. The awards will be announced during the closing ceremony of MIDL.

### IMPACT AWARDS

Two Philips Impact Awards, of 1000 euros each, will be awarded to the two contributions that describe practical applications of novel science and technology with a great promise to be of significant benefit to society and patients. For the 'impact' awards the program chairs identified papers they believe have great promise for practical applications and impact on society. The selected papers will be ranked by a separate committee and discussed. The best two papers will be given an Impact award. The awards will be announced during the closing ceremony of MIDL.



### CIFAR STUDENT TRAVEL GRANTS

The CIFAR 'Student Travel' grants will be awarded to:

- The best first author student papers as based on review scores
- Student first authors of accepted papers from lower-income countries or other underrepresented groups

The grant will cover conference registration and a double room for three nights at the conference hotel. The grant will be awarded by the program chairs and decision will be rendered before the conference. Reimbursement of the costs will happen within three to six weeks after the conference.

## VENUE



## LOCATION

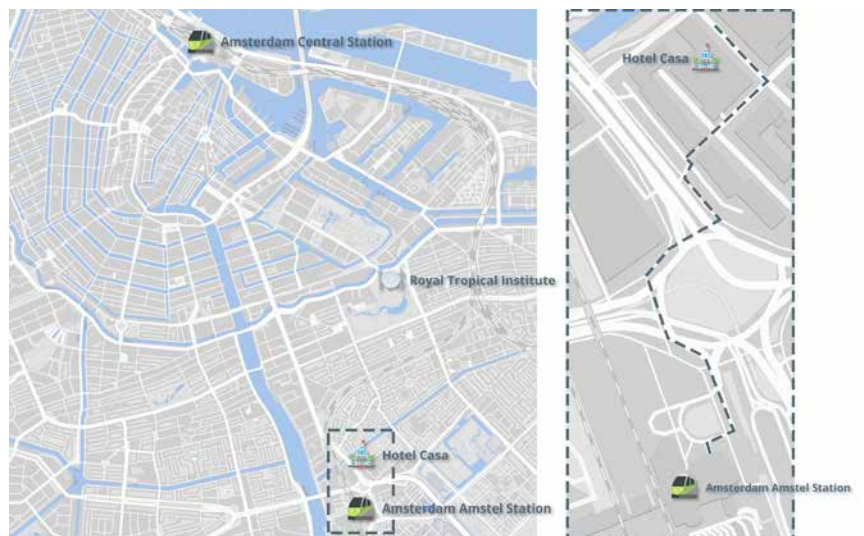
Hotel Casa is located in the center of historic Amsterdam, close to major sights such as the Rijksmuseum. It has modern conference rooms with high-speed WiFi and excellent audio-visual equipment. Furthermore, it has an on-site bar, rooftop terrace and the East57 restaurant. The restaurant serves local dishes, salads and cheeses. It also features a wine bar where guests can enjoy snacks and choose from a selection of over 100 wines.

## HOW TO GET THERE?

Situated only a stone throw away from the Amsterdam Amstel Station and Amsterdam's ring road A10 makes Casa easily accessible both by car and public transport. Indoor car parking is available, leaving you carefree.

### BY CAR

As traffic around Amsterdam can be jammed, it is advised to use navigation with traffic updates (e.g. Google Maps) to plan your route when you leave. In general, as soon as you reach Amsterdam, take the A10 ring road, and then exit 12 towards Amsterdam-



Duivendrecht. Subsequently, use the left 2 lanes to turn left onto Gooiseweg/s112 (signs for Centrum). At the Prins Bernhardplein, take the first exit onto Wibautstraat and then the first right onto Ringdijk. The Ringdijk turns right and becomes Eerste Ringdijkstraat. Hotel Casa will be at your right side.

## BY TRAIN

The easiest route is to take a train to Amsterdam Amstel Station. From here it is a 300 meter walk to Hotel Casa. See the map on the previous page for more details.

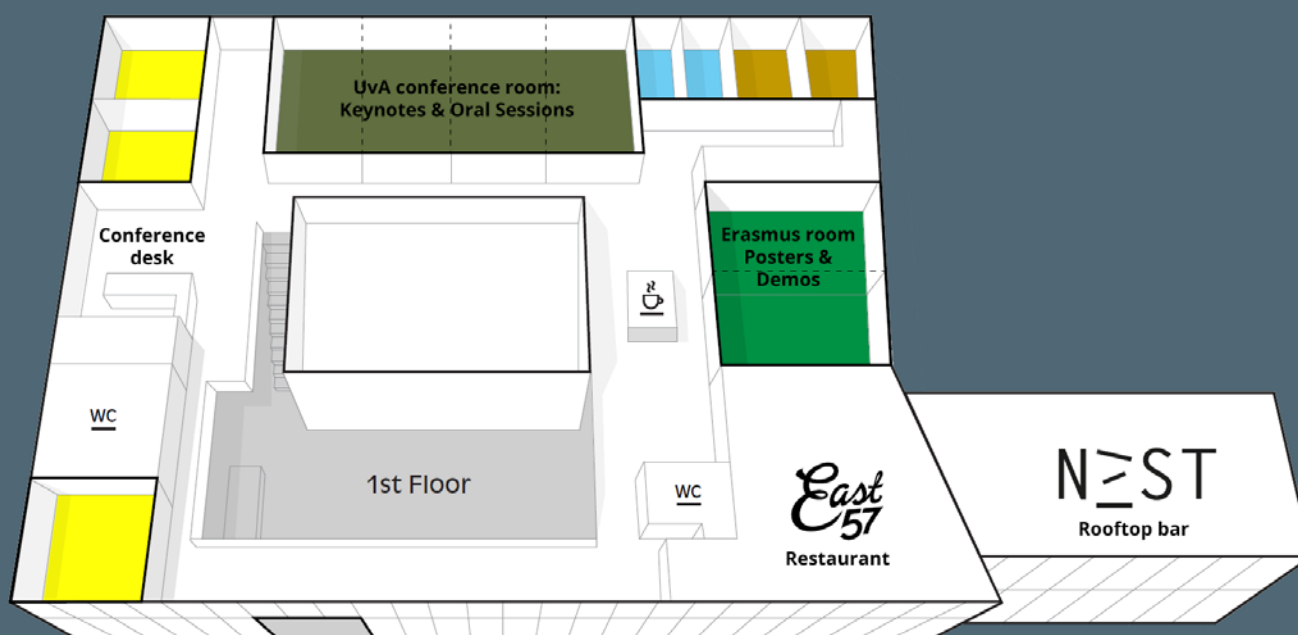
## FROM SCHIPHOL AIRPORT

Roughly every 10 minutes a train leaves for Amsterdam Central Station. From Amsterdam Central Station a train leaves every 5 minutes towards Amsterdam Amstel Station.

## AT THE CONFERENCE

### CONFERENCE ROOMS

The conference will take place on the 1st floor of Hotel Casa, a map of the interior is provided below. After going up the stairs you will find the conference desk immediately to your left. Here you have to pick up your badge and registration material. The keynotes, oral sessions, panel discussion and awards ceremony will be in the UvA conference rooms, immediately across the stairs. Poster sessions will be held in the Erasmus room and the adjacent hallway.



### COFFEE BREAKS AND LUNCHES

Coffee breaks and lunches are included in the registration fee. During the coffee breaks light snacks will be available. Coffee breaks and lunches will be served in the hallway next to the Erasmus room (poster room). Throughout the 1st floor several coffee machines are available and can be used freely by conference attendees. If you have any dietary restrictions, make yourself known to the conference organizers or the hotel staff such that the appropriate dishes can be provided to you during lunch.

### WI-FI

High speed Wi-Fi is available throughout the building.



## GENERAL INFORMATION

### FOR ATTENDEES

#### AMSTERDAM

Amsterdam is a relatively compact city in terms of size, which means it is easily walkable. Nevertheless, Amsterdam can compete with the biggest cities in terms of sights, entertainment, nightlife and dining. From its amazing museums such as the Van Gogh and Rijksmuseum to the Heineken Experience and strolling in the Vondelpark, there is something to do for everybody.

Amsterdam is considered to be a relatively safe city. In general, violent crimes are as rare as in other European cities. However, as in most crowded cities, beware of pick-pockets; they are mainly active in crowded areas, and on the trains connecting Amsterdam Central Station and Schiphol Airport. Watch your belongings carefully.

More information about Amsterdam can be found at: [www.iamsterdam.nl](http://www.iamsterdam.nl)



## IMPORTANT INFORMATION

<b>National Emergency numbers:</b>	+31 112
<b>Police, no emergency:</b>	+31 900 8844
<b>Currency:</b>	The currency in the Netherlands is the Euro. ATMs can be found throughout all cities. Debit cards (Maestro) are accepted almost everywhere. Credit cards are generally accepted in Amsterdam, but are not as common. When in doubt, ask!
<b>Electricity:</b>	Within the Netherlands 230 Volts / 50 Hertz electrical supply is used. Visitors may need converters and adapters.
<b>Cycling:</b>	Cycling is a fun and easy way to get around Amsterdam. Many rental companies are available throughout the city, such as the Yellow Bike Rental at Amsterdam Central Station. Hotel Casa also offers bike rentals.
<b>Train:</b>	Information on tickets and train times can be found on <a href="http://www.ns.nl/en">www.ns.nl/en</a>
<b>Bus/Metro/Tram:</b>	Time tables and ticket information for other public transport options can be found on <a href="http://9292.nl/en">9292.nl/en</a>
<b>Taxi:</b>	Taxis are recognizable by their roof lights and blue license plates. Meters should always be turned on. Uber also services Amsterdam.
<b>Airport:</b>	Schiphol Airport is the main international airport of the Netherlands. For more information on travel to and from Schiphol, please check: <a href="http://www.schiphol.nl/en">www.schiphol.nl/en</a>

## THE CONFERENCE

During registration you will receive an attendee welcome package, which will include a name badge. Please have this badge with you at all times when visiting conference events, it is your entrance ticket.

Although MIDL does not publish official proceedings, you can find all papers and their reviews via OpenReview: <https://openreview.net/group?id=MIDL.amsterdam/2018>.

During the conference we will communicate any important information via the MIDL website, <https://midl.amsterdam>, the MIDL Twitter account, [https://twitter.com/midl\\_amsterdam](https://twitter.com/midl_amsterdam), and e-mail. If you have any urgent questions during the conference, please first ask at the conference desk or at the hotel reception. You can also always approach the conference chairs or send an e-mail to [info@midl.amsterdam](mailto:info@midl.amsterdam).

## FOR PRESENTERS

### POSTER PRESENTATION

The poster format is A0 portrait. Poster boards are 841 mm wide x 1189 mm tall (equivalent to 33.1 inch wide x 46.8 inch tall). Adhesive material and/or pins will be provided for mounting the posters to the boards. Each poster will be assigned a poster number which will be indicated on the poster boards. Presenters are asked to install their posters during the coffee break preferably on July 4th. We strongly encourage the authors to leave the posters installed during the whole conference. Posters are to be removed from the poster boards by the presenters after the closing ceremony.

### ORAL PRESENTATION

Each oral presentation is allocated a 20-minute slot. Presentations must not exceed 15 minutes leaving 5 minutes for questions and discussion. Please prepare your presentations in Power Point or PDF format. Note that the format of the beamer is 16:9. Authors are required to upload their presentation to the computer installed in the room prior to the oral session. We will NOT connect your personal laptop to the presentation system. We would also urge you to be present at least 10 minutes before the start of your session and make yourself known to the session chairs.

## SPONSORS

We would like to thank our sponsors for their generous contributions. It is great to see such a strong interest of industry in the integration of machine learning and medical imaging.

### PLATINUM




### GOLD



### SILVER





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## ORGANIZING COMMITTEE

### CONFERENCE CHAIRS

Bram van Ginneken	Radboud University Medical Center, Nijmegen, The Netherlands
Max Welling	University of Amsterdam, The Netherlands

### PROGRAM CHAIRS

Ivana Išgum	University Medical Center Utrecht, The Netherlands
Clarisa Sánchez	Radboud University Medical Center, Nijmegen, The Netherlands
Geert Litjens	Radboud University Medical Center, Nijmegen, The Netherlands

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Holger Roth	Nagoya University, Japan
Michiel Schaap	HeartFlow, Redwood City, CA, United States
Dinggang Shen	UNC IDEA Group, Chapel Hill, NC, United States
Graham Taylor	University of Guelph, Canada
Jakub Tomczak	University of Amsterdam, The Netherlands
Tom Vercauteren	University College London, United Kingdom
Mitko Veta	Eindhoven University of Technology, The Netherlands
S. Kevin Zhou	Siemens Healthineers, Princeton, NJ, United States

# Deep Learning Applied



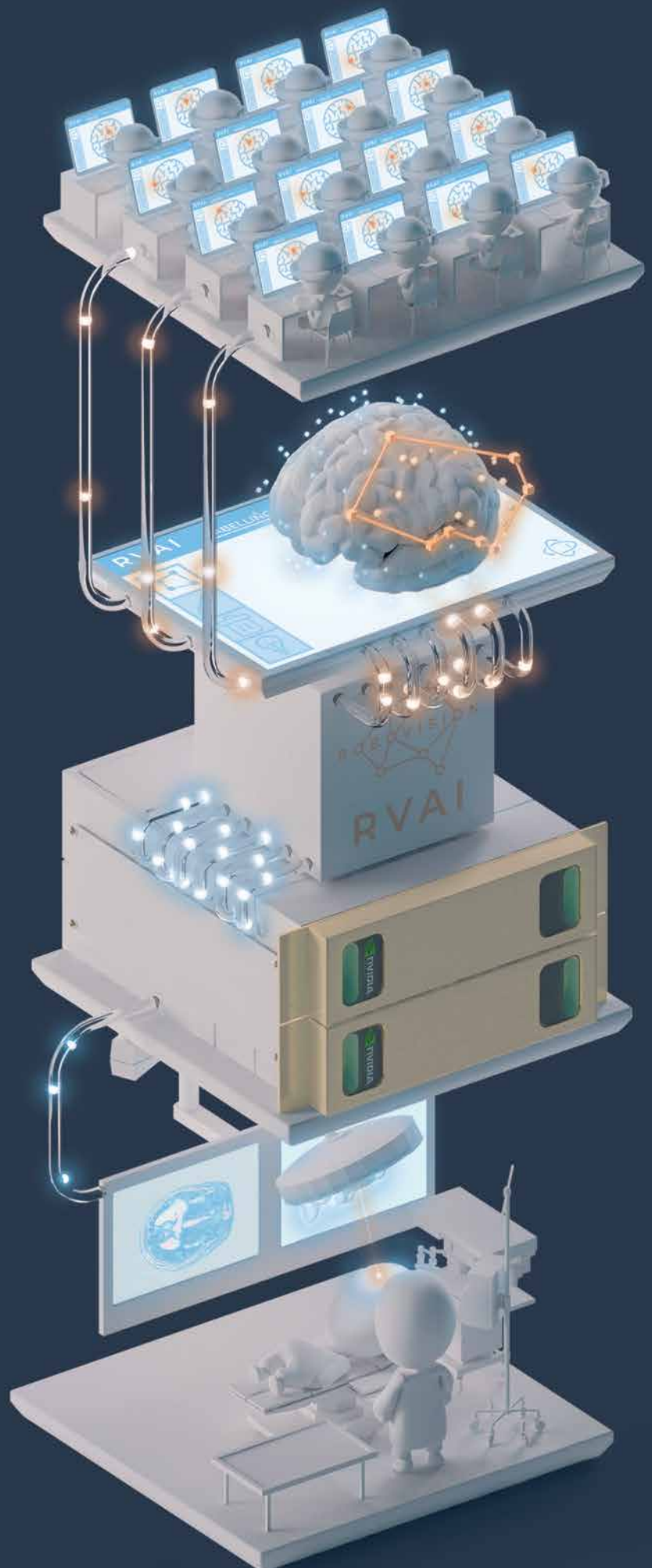
For the past 10 years **Robovision** has been focussing on everything AI, Computer Vision and Robotics. We create value for our customers by optimising and automating processes and building solutions that put the machines to work. We simplify the work of AI departments and researchers with our RVAI Engine that handles all steps from unstructured data to AI-model deployment and minimizes time spent on tasks that do not require PhDs (such as labelling data). Together with the most advanced AI technology from Nvidia, we accelerate building the intelligence of tomorrow.

> [www.robovision.ai](http://www.robovision.ai)



**Bagaar** is an industry 4.0 integrator, we support companies in their digital ventures by inventing, creating and developing tools, applications and Internet of Things Solutions. Through innovation, user experience design, human interface design and in-house engineering and development, Bagaar can build virtually any application or platform. Bagaar is preferred integration-partner of Robovision.

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We would like to thank and acknowledge our reviewers for their hard work and making this inaugural edition of MIDL possible!

Samaneh Abbasi Sureshjani	Eindhoven University of Technology
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Ninon Burgos	INRIA
Juan Cerrolaza	Imperial College London
Yijiang Chen	Case Western Reserve University
Grzegorz Chlebus	Fraunhofer MEVIS
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Areum Lee	Korea University
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Jihye Yun	Asan Medical Center
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# NOTES







