

# Danielle F. Pace, Ph.D.

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## EDUCATION

**Massachusetts Institute of Technology**, Cambridge, MA, USA Sept 2013-Jun 2020  
**Ph.D., Computer Science** (GPA: 4.9/5.0)

- Thesis: "Image segmentation for highly variable anatomy: Applications to congenital heart disease"
- Selected Coursework: Machine Learning, Inference and Information, Advances in Computer Vision, Shape Analysis
- Advisor: Dr. Polina Golland

**The University of North Carolina at Chapel Hill**, Chapel Hill, NC, USA Apr 2012-May 2013  
**Non-Degree Graduate Studies, Mathematics (part-time)**

**The University of Western Ontario**, London, ON, Canada Sept 2007-Mar 2010  
**M.E.Sc., Biomedical Engineering** (Avg: 92/100)

- Thesis: "Real-time 4D ultrasound reconstruction for image-guided intracardiac interventions"
- Advisor: Dr. Terry Peters

**Queen's University**, Kingston, ON, Canada Sept 2003-Apr 2007  
**B.Cmp.H., Biomedical Computing** (Avg: 91/100)

- Undergraduate Project: "Visualization for computer-assisted image-free total hip replacement"
- Advisor: Dr. Randy Ellis

## EXPERIENCE

**The Broad Institute of MIT and Harvard**, Cambridge, MA, USA Jul 2023-now  
*Senior Machine Learning Scientist*

- Developing and applying machine learning techniques for analysis of large clinical datasets in the "Machine Learning for Health" team, including imaging, electrocardiogram and electronic health record data

**A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital**, Boston, MA, USA Jul 2020-Jul 2023  
*Research Fellow*

- Developed new deep learning and anatomical modelling algorithms for neuroimaging data, by combining deep Bayesian image segmentation with image synthesis for robust segmentation of contrast-agnostic MR scans
- Advisors: Dr. Adrian Dalca and Dr. Bruce Fischl

**Computer Science and Artificial Intelligence Laboratory, MIT**, Cambridge, MA, USA Jun-Jul 2020  
*Research Specialist*

- Refined machine learning-based cardiac segmentation algorithms for patients with congenital heart disease
- Advisor: Dr. Polina Golland

**Computer Science and Artificial Intelligence Laboratory, MIT**, Cambridge, MA, USA Sept 2013-Jun 2020  
*Graduate Student Researcher*

- Conceived and implemented new machine learning algorithms for image segmentation, from data collection and annotation through algorithm development and experimental validation
- Demonstrated improved accuracy in cardiac MR datasets with extreme variability caused by severe congenital heart defects that alter the size, shape, number, location and connectivity of cardiac structures ([link](#))
- Advisor: Dr. Polina Golland

**Philips Research**, Hamburg, Germany Jun-Aug 2017  
*Visiting Ph.D. Candidate*

- Collaborated with Philips researchers on my Ph.D. projects on machine learning for cardiac image segmentation
- Advisor: Dr. Jürgen Weese

**Kitware Inc.**, Carrboro, NC, USA Jul 2010-Jun 2013  
*Research and Development Engineer*

- Conducted research formulating, implementing and validating a new deformable image registration method to better model the sliding motion of the lungs and abdominal organs ([link](#))
- Wrote custom C++ software in a multi-developer team for a major orthopedic device manufacturer, including bone morphological population analyses and implant design. Progressed to co-lead responsible for defining software requirements, conducting code reviews, supervising personnel, and leading customer presentations
- Led and co-wrote two successful NIH grants on medical image analysis, in collaboration with academic partners
- Advisor: Dr. Stephen Aylward

**Brigham & Women's Hospital and Harvard Medical School, Boston, MA, USA**

May-Aug 2007

*Research Assistant*

- Developed a 3D Slicer tutorial model incorporating a LEGO robot, for hands-on training in image-guided therapy
- Advisor: Dr. Nobuhiko Hata

**Dept. of Physiology, Queen's University, Kingston, ON, Canada**

May 2005-Aug 2006

*Research Assistant*

- Created computational models of motoneurons to investigate how background synaptic activity affects firing rate
- Advisor: Dr. Ken Rose

## **TEACHING AND MENTORSHIP**

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**MIT, Cambridge, MA, USA**

Jan 2016-Jul 2020

*Undergraduate Mentorship*

- Mentored six MIT undergraduate students for projects in machine learning and image annotation

**Dept. of Electrical Engineering and Computer Science, MIT, Cambridge, MA, USA**

Sept-Dec 2016

*Teaching Assistant, "Introduction to Inference"*

- Offered weekly lectures reviewing class material for 85 students, held weekly office hours and developed class assignments, achieving an excellent student rating (6.5/7)

**Dept of Electrical and Computer Engineering, The University of Western Ontario, London, ON, Canada**

Jan-Apr 2009

*Teaching Assistant, "Algorithms and Data Structures for Object-Oriented Design"*

- Designed and graded assignments and weekly labs, and ran office hours

**National Center for Image-Guided Therapy (NCIGT)**

Mar-Dec 2008

*Training Specialist*

- Developed new 3D Slicer tutorials and taught interactive training workshops

**Dept. of Electrical and Computer Engineering, The University of Western Ontario, London, ON, Canada**

Sept-Dec 2007

*Teaching Assistant, "Programming Fundamentals for Engineers"*

- Taught core principles and debugging strategies to novice programmers

## **AWARDS**

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- **Outstanding Reviewer Award**, MICCAI, 2021 (top 10/1220 reviewers)
- **Best Presentation**, New England Computer Vision Workshop, 2018
- **NSERC Canada Graduate Scholarship (Doctoral)**, 2013-2016 (\$63,000)
- **Best Student Poster**, International Society for Computer Aided Surgery, 2010
- **1<sup>st</sup> Poster in Imaging for Cardiovascular Therapeutics**, 7<sup>th</sup> Symposium of Imaging Network Ontario, 2008
- **NSERC Canada Graduate Scholarship (Master's)**, 2007-2009 (\$35,000)
- **Ontario Graduate Scholarship**, Government of Ontario, 2007 (\$15,000, declined to take up NSERC)
- **Advanced Undergraduate Project Award**, School of Computing, Queen's University, 2007
- **Best Undergraduate Contribution**, Canadian Student Conference on Biomedical Computing, 2006
- **HSBC Bank Malta Undergraduate Scholarship**, 2003-2007 (\$10,000)
- **Principal's Scholarship in Computing**, Queen's University, 2003-2005 (\$8,000)

## **SERVICE**

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**Organizing Committee:**

- **MedNeurIPS Workshop (NeurIPS 2022)**: Medical Imaging meets NeurIPS
- **HVSMR Challenge (MICCAI 2016)**: Whole Heart and Great Vessel Segmentation from 3D Cardiovascular Magnetic Resonance Images in Congenital Heart Disease

**Leadership:**

- **MICCAI Student Board**: Advisory Member (2018-2020), Educational Officer (2017-2018), Professional Students Event Officer (2016-2017), Executive Member (2015-2016)
- **MIT Canadians Club**: Deputy Prime Minister (2014-2015 and 2016-2017), Minister of Finance (2015-2016)

**Technical Reviewer:**

- IEEE Transactions on Medical Imaging (TMI)
- Medical Image Analysis (MEDIA)
- Transactions on Pattern Analysis and Machine Intelligence (TPAMI)
- Journal of Cardiovascular Magnetic Resonance (JCMR)
- Journal of Medical Imaging (JMI)
- Ultrasonics
- Medical Image Computing and Computer Assisted Intervention (MICCAI)

- Neural Information Processing Systems (NeurIPS)
- Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence (AAAI)
- ACM Conference on Health, Inference, and Learning (ACM-CHIL)
- NeurIPS Machine Learning for Health (ML4H)
- Information Processing in Computer Assisted Interventions (IPCAI)
- MICCAI Workshop on Clinical Image-Based Procedures (CLIP)
- MICCAI Workshop on Computational and Clinical Applications in Abdominal Imaging (ABDI)

## **SKILLS**

**Technical:** Python, C++, TensorFlow, Keras, NumPy, ITK, VTK, MATLAB, SQL, Git/GitHub, Bash, DICOM

**Languages:** English (native), German (limited working proficiency)

## **PEER-REVIEWED JOURNAL PUBLICATIONS**

1. **D.F. Pace**, H.T.M Contreras, J. Romanowicz, S. Ghelani, I. Rahaman, Y. Zhang, P. Gao, M.I. Jubair, T. Yeh, P. Golland, T. Geva, S. Ghelani, A.J. Powell, M.H. Moghari. HVSMR-2.0: A 3D cardiovascular MR dataset for whole-heart segmentation in congenital heart disease. *Nature Scientific Data* 11:721, 2024.
2. V. Nauffal, M.D.R. Klarqvist, M.C. Hill, **D.F. Pace**, P. Di Achille, S.H. Choi, J.T. Rämö, J.P. Pirruccello, P. Singh, S. Kany, C. Hou, K. Ng, A.A. Philippakis, P. Batra, S.A. Lubitz, P.T. Ellinor. Non-invasive assessment of organ-specific and shared pathways in multi-organ fibrosis using T1 mapping. *Nature Medicine* 30:1749-1760, 2024.
3. S.T. Arasteh, J. Romanowicz, **D.F. Pace**, P. Golland, A.J. Powell, A.K. Maier, D. Truhn, T. Brosch, J. Weese, M. Lotfinia, R.J. van der Geest, M.H. Moghari. Automated segmentation of 3D cine cardiovascular magnetic resonance imaging, *Frontiers in Cardiovascular Medicine* 10, 2023.
4. **D.F. Pace**, A.V. Dalca, T. Brosch, T. Geva, A.J. Powell, J. Weese, M.H. Moghari, P. Golland. Learned iterative segmentation of highly variable anatomy from limited data: Applications to whole heart segmentation for congenital heart disease, *Medical Image Analysis* 80:102469, 2022.
5. A. Bayat, **D.F. Pace**, A. Sekuboyina, C. Payer, D. Stern, M. Urschler, J.S. Kirschke, Bjoern H. Menze, Anatomy-aware inference of the 3D standing spine posture from 2D radiographs, *Tomography* 8(1):479-496, 2022.
6. C. Herz, **D.F. Pace**, N.H. Nam, A. Lasso, P. Dinh, P. Golland, M.A. Jolley, Segmentation of tricuspid valve leaflets from transthoracic 3D echocardiograms of children with hypoplastic left heart syndrome using deep learning, *Frontiers in Cardiovascular Medicine* 8, 2021.
7. **D.F. Pace**, S.R. Aylward, M. Niethammer, A locally adaptive regularization based on anisotropic diffusion for deformable image registration, *IEEE Transactions on Medical Imaging*; 32(11): 2114-2126, 2013.
8. A. Irimia, B. Wang, S. Aylward, M. Prastawa, **D.F. Pace**, M. Niethammer, G. Gerig, D.A. Hovda, R. Kikinis, P.M. Vespa, J.D. Van Horn, Neuroimaging of structural pathology and neuroconnectivity in traumatic brain injury: towards personalized outcome prediction, *NeuroImage: Clinical*; 1:1-17, 2012.

## **PEER-REVIEWED CONFERENCE PROCEEDINGS**

9. **D.F. Pace**, A.V. Dalca, T. Brosch, T. Geva, A.J. Powell, J. Weese, M.H. Moghari, P. Golland, Iterative segmentation from limited training data: Applications to congenital heart disease, *MICCAI Workshop on Deep Learning in Medical Image Analysis*, LNCS 11045:334-342, 2018.
10. **D.F. Pace**, A.V. Dalca, T. Geva, A.J. Powell, M.H. Moghari, P. Golland, Interactive whole-heart segmentation in congenital heart disease, *Medical Image Computing and Computer Assisted Interventions (MICCAI)*, LNCS 9351:80-88, 2015.
11. R. Kwitt, **D.F. Pace**, M. Niethammer, S.R. Aylward, Studying cerebral vasculature using structure proximity and graph kernels, *Medical Image Computing and Computer Assisted Interventions (MICCAI)*, LNCS 8150:534-541, 2013.
12. **D.F. Pace**, M. Niethammer, S.R. Aylward, Sliding geometries in deformable image registration, *MICCAI Workshop on Computational and Clinical Applications in Abdominal Imaging*, LNCS 7029:141-148, 2011.
13. M. Niethammer, G.L. Hart, **D.F. Pace**, P.M. Vespa, A. Irimia, J.D. Van Horn, S.R. Aylward, Geometric Metamorphosis, *Medical Image Computing and Computer Assisted Interventions (MICCAI)*, LNCS 6892:639-646, 2011.
14. **D.F. Pace**, A. Enquobahrie, H. Yang, S.R. Aylward, M. Niethammer, Deformable image registration of sliding organs using anisotropic diffusive regularization, *International Symposium on Biomedical Imaging (ISBI)*, 30:407-413, 2011.
15. T. Peters, **D.F. Pace**, P. Lang, G. Guiraudon, D. Jones, C. Linte, Ultrasound image guidance of cardiac interventions, *Proceedings of SPIE Medical Imaging*; 7968:79680T, 2011.
16. C.A. Linte, M. Carias, S.D. Cho, **D.F. Pace**, J. Moore, C. Wedlake, D. Bainbridge, B. Kiaii, T.M. Peters, Estimating heart shift and morphological changes during minimally invasive cardiac interventions, *Proceedings of SPIE Medical Imaging*; 7625:762509, 2010.
17. **D.F. Pace**, D.G. Gobbi, C. Wedlake, J. Gumprecht, J. Boivert, J. Tokuda, N. Hata, T.M. Peters, An open-source real-time ultrasound reconstruction system for four-dimensional imaging of moving organs, *MICCAI Workshop on Systems and Architectures for Computer Assisted Intervention*, 2009.
18. J. Moore, C. Clarke, D. Bainbridge, C. Wedlake, A.D. Wiles, **D.F. Pace**, T.M. Peters, Image guidance for spinal facet injections using tracked ultrasound, *Medical Image Computing and Computer Assisted Interventions (MICCAI)*, LNCS 5761:516-523, 2009.
19. T.M. Peters, C.A. Linte, J. Moore, A. Wiles, J. Lo, **D.F. Pace**, C. Wedlake, D. Bainbridge, D.L. Jones, G.M. Guiraudon, Cardiac imaging and modeling for guidance of minimally invasive beating heart interventions, *Functional Imaging and Modeling of the Heart*, LNCS 5528:466-475, 2009.

20. **D.F. Pace**, A.D. Wiles, J. Moore, C. Wedlake, D.G. Gobbi, T.M. Peters, Validation of four-dimensional ultrasound for targeting in minimally-invasive beating-heart surgery, Proceedings of SPIE Medical Imaging; 7261:726115, 2009.
21. J. Jomier, L. Ibanez, A. Enquobahrie, **D.F. Pace**, K. Cleary, An open-source testing framework for tracking devices using Lego Mindstorms™, Proceedings of SPIE Medical Imaging; 7261:72612S, 2009.
22. **D.F. Pace**, R. Kikinis, N. Hata, An accessible, hands-on tutorial system for image-guided therapy and medical robotics using a robot and open source software, MICCAI Workshop on Open Source and Open Data, 2007.

#### **PEER-REVIEWED CONFERENCE ABSTRACTS**

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- D.F. Pace**, Polina Golland, David Annese, Tal Geva, Andrew J. Powell, M.H. Moghari, Creating 3D heart models of children with congenital heart disease using magnetic resonance imaging, International Society for Magnetic Resonance in Medicine (ISMRM), 2015.
23. Y. Dai, **D.F. Pace**, J. Bischoff, Anthropometric differences in natural posterior tibial slope, Orthopaedic Research Society (ORS), 2014.
  24. **D.F. Pace**, A. Enquobahrie, P. Reynolds, J. Jomier, E. Bullitt, S.R. Aylward, TubeTK: An open-source toolkit of algorithms operating on images of tubes, 26<sup>th</sup> International Congress and Exhibition on Computer Assisted Radiology and Surgery (CARS), International Journal of CARS; 7 (S1):S79-S80, 2012.
  25. **D.F. Pace**, D. Bainbridge, J. Moore, C. Wedlake, G. Guiraudon, D.L. Jones, T.M. Peters, Real-time 4D ultrasound reconstruction for improved intraoperative imaging during image-guided beating-heart interventions, 24<sup>th</sup> International Congress and Exhibition on Computer Assisted Radiology and Surgery (CARS), International Journal of CARS; 5(S1):S271-S273, 2010.  
*Won International Society for Computer Aided Surgery (ISCAS) Best Student Poster award.*
  26. C.A. Linte, D.S. Cho, M. Carias, **D.F. Pace**, J. Moore, C. Wedlake, D. Bainbridge, B. Kiaii, T.M. Peters, Estimating heart movement and morphological changes during robot-assisted coronary artery bypass graft interventions, 24<sup>th</sup> International Congress and Exhibition on Computer Assisted Radiology and Surgery (CARS), 2010.
  27. **D.F. Pace**, T. Bui, P.K. Rose, Computational estimates of the effect of asynchronous synaptic activity on fluctuations in the membrane potential of motoneurons, Society for Neuroscience (SfN), 2006.

#### **BOOKS AND PROCEEDINGS**

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M.A. Zuluaga, K. Bhatia, B. Kainz, M.H. Moghari, **D.F. Pace** (eds). Reconstruction, segmentation and analysis of medical images, First International Workshops, RAMBO 2016 and HVSMR 2016. LNCS 10129, 2016.

#### **THESES**

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28. **D.F. Pace**, Image segmentation for highly variable anatomy: Applications to congenital heart disease, Ph.D. Thesis, Cambridge, MA, USA: Massachusetts Institute of Technology, June 2020.
29. **D.F. Pace**, Real-time 4D ultrasound reconstruction for image-guided intracardiac interventions, M.E.Sc. Thesis. London, ON, Canada: The University of Western Ontario, March 2010.