

# DIRK PADFIELD

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## Qualifications

- Applied research experience since 2002 developing image processing, computer vision, and machine learning algorithms for quantitative image analysis with a focus on graph-theoretic algorithms, wavelets and Fourier analysis, level-sets and fast-marching, interactive algorithms, mathematical modeling, classification, and machine learning.
- 5 first-author journal publications, 2 book chapters, 33 peer-reviewed conference publications, and 16 issued patents.
- Extensive Python and C++ programming experience for developing algorithms, and 6 years as an active developer of the open-source C++ Insight Toolkit (ITK)
- Delivered products for large-scale automated product image quality assessment; cell segmentation, tracking, and registration; molecular pathology tissue classification; automated aircraft blade defect detection; interactive Ultrasound, CT, and PET nodule detection and segmentation.

## Education

- **Rensselaer Polytechnic Institute**—Troy, NY  
*Ph.D. in Computer Science: Graduated May 2009*
  - GPA: 4.0
  - Thesis title: “Segmentation and Tracking Algorithms for Monitoring Cellular Motion and Function”
- **Pennsylvania State University**—University Park, PA  
*M.S. in Electrical Engineering: Graduated May 2002*
  - GPA: 3.96
  - Thesis title: “Integrated Image Registration and Tracking of Endoscopic Video and 3D CT Images”
  - Earned a 3-year National Science Foundation (NSF) Graduate Fellowship Award
  - Earned a National Science Foundation (NSF) Summer Program in Taiwan Award
- **Pennsylvania State University**—University Park, PA  
*B.S. in Electrical Engineering and B.S. in International Studies: Graduated May 2000*
  - GPA: 3.84
  - Thesis title: “Gerdien Condenser Data Reduction and Analysis Using MATLAB Graphical User Interfaces”
- **American University in Cairo**—Cairo, Egypt  
*Two semesters of study abroad: 1997-1998*

## Work Experience

- **Amazon**—Seattle, WA  
*Senior Applied Research Scientist: September 2014-present*
  - Developing novel machine learning, deep learning, and image analysis algorithms for large-scale image quality assurance in a big data environment. Responsible for collecting data through SQL queries, data cleaning for classifier training, designing algorithms for detecting quality criteria, evaluating algorithms on large-scale data, pushing the algorithms to production, and developing and monitoring metrics for measuring performance over time.
- **GE Global Research Center**—Niskayuna, NY  
*Senior Computer Scientist: November 2002-September 2014*
  - Invented novel segmentation, tracking, and registration algorithms for biomedical/medical image analysis applications with particular focus on microscopy, molecular pathology, and ultrasound.
  - Invented a robust graph-theoretic object tracking algorithm based on the minimum-cost flow approach to solve multiple assignments in a consistent framework. Demonstrated the tracking of over 400,000 cells by matching detections that account for the cell behaviors of splitting, merging, entering, leaving, moving, and dying. Published in the IPMI conference and the Medical Image Analysis journal.
  - Designed a method and derived the equations to embed the spatial masking step of registration into the Fourier domain to enable fast masked image registration. Demonstrated the algorithm for translation, rotation, and scale on a wide range of applications. Contributed the C++ implementation to the Insight Toolkit (ITK). Published in the CVPR conference and the Transactions on Image Processing journal.
  - Discovered and derived the "magic sigma", a family of sigma values that enable the exact representation of a discrete Gaussian kernel whose entries are integers and powers-of-two. This enables efficient convolution through bit-wise shifts without the need for floating-point operations, which is especially important for mobile and embedded devices. Published in the CVPR conference.
- **Rensselaer Polytechnic Institute**—Troy, NY  
*Adjunct Faculty: Spring 2014*
  - Taught a graduate-level course on Biological Image Analysis
- **The National Science Foundation (NSF) and the National Science Council of Taiwan**—Taoyuan, Taiwan, R.O.C.  
*Research Scientist: Summer 2002*
  - Studied and presented seminars on algorithms for human DNA database queries
- **The National Aeronautics and Space Administration (NASA)**—Goddard Space Flight Center, Greenbelt, MD and Andoya Rocket Range, Andenes, Norway  
*Research Scientist: Summer 1999 and Summer 2000*
  - Constructed, tested, and launched noctilucent cloud measuring devices with NASA

## Programming Experience

- **Programming Languages:** C/C++, Python
- **Software Libraries:** ITK, VTK, Matlab, L<sup>A</sup>T<sub>E</sub>X
- **Version Control:** GIT, SVN, CVS
- **IDEs:** Eclipse, Xcode, Visual Studio
- **Operating Systems:** Linux, Mac, Windows

## Language Experience

- **Languages:** English (fluent), Norwegian (fluent), Arabic (working), German (working)

## Professional Service

- Served on the organizing committees of the ISBI 2015 and ISBI 2016 conferences
- Journal reviewing: Elsevier Medical Image Analysis, IEEE Medical Imaging, IEEE Image Processing, IEEE Biomedical Engineering, IEEE Information Technology in Biomedicine, Cytometry, Journal of Microscopy, Optical Engineering, Annals of Applied Statistics
- Conference reviewing: IEEE CVPR, IEEE ICCV, MICCAI, IEEE ISBI, IEEE ICIP, IEEE EMBC

## Peer-Reviewed Journal Publications

- [1] D. Padfield. Masked object registration in the Fourier domain. *IEEE Transactions on Image Processing*, 21(5):2706–2718, 2012.
- [2] D. Padfield, J. Rittscher, and B. Roysam. Coupled minimum-cost flow cell tracking for high-throughput quantitative analysis. *Elsevier Medical Image Analysis*, 15(4):650–668, 2011.
- [3] D. Padfield, J. Rittscher, N. Thomas, and B. Roysam. Spatio-temporal cell cycle phase analysis using level sets and fast marching methods. *Elsevier Medical Image Analysis*, 13(1):143–155, 2009.
- [4] D. Padfield and J. Miller. A label geometry image filter for multiple object measurement. *Insight Journal*, 2008.
- [5] D. Padfield, G. Brooksby, and R. Kaucic. Automatic deformation detection for aircraft engine disk inspection. *Journal of Multimedia*, 2(4), 2007.

## Book Chapters

- [1] D. Padfield, P.R.S. Mendonca, and Sandeep Gupta. *Healthcare Data Analytics*, chapter 3: Biomedical Image Analysis, pages 61–89. CRC Press, 2015.
- [2] D. Padfield, J. Rittscher, N. Thomas, and B. Roysam. *Microscopic Image Analysis for Life Science Applications*, chapter 12: Automated Spatio-Temporal Cell Cycle Phase Analysis Based on Covert GFP Sensors, pages 295–316. Artech Publishing House, 2008.

## Issued Patents

- [1] **D. Padfield**. Composite image quality assurance. Issued Patent, February 2018. Patent number US9,898,812.
- [2] W. You, **D. Padfield**, and G. Swaminathan. Gap shifting for automatic recognition of tabular text. Issued Patent, October 2017. Patent number US9,792,524.
- [3] P. Mendonca, **D. Padfield**, C. Aladahalli, S. Liu, and T. Broniak. Systems and methods for determining parameters for image analysis. Issued Patent, April 2016. Patent number US9,324,155.
- [4] Y. Al-Kofahi, **D. Padfield**, and A. Seppo. Systems and methods for using an immunostaining mask to selectively refine ISH analysis results. Issued Patent, September 2015. Patent number US9,135,694.
- [5] X. Liu and **D. Padfield**. Automatic segmentation and characterization of cellular motion. Issued Patent, June 2015. Patent number US9,070,004.
- [6] Y. Al-Kofahi, **D. Padfield**, and A. Seppo. Method and systems for cell-level FISH dot counting. Issued Patent, May 2015. Patent number US9,042,631.
- [7] A. Santamaria-Pang, J. Rittscher, **D. Padfield**, A. Can, Z. Pang, M. Bello, F. Ginty, C. Sevinsky, Q. Li, M. Rothney, and B. Sarachan. System and method for multiplexed biomarker quantitation using single cell segmentation on sequentially stained tissue. Issued Patent, March 2015. Patent number US8,995,740.
- [8] P. Annangi, J. Banerjee, and **D. Padfield**. Methods and systems for estimating gestation age of a fetus. Issued Patent, September 2014. Patent number US8,845,539.
- [9] N. Subramanian, A. Narasimhamurthy, S. Thiruvankadam, and **D. Padfield**. Methods and apparatus for automated measuring of the interventricular septum thickness. Issued Patent, May 2014. Patent number US8,715,183.
- [10] J. Rittscher, R. Bhotika, K. Mosaliganti, **D. Padfield**, and R. Machiraju. Methods and systems for automated segmentation of dense cell populations. Issued Patent, April 2014. Patent number US8,712,139.
- [11] M. Bello, J. Rittscher, A. Yekta, **D. Padfield**, and J. Tu. Systems and methods for automated extraction of high-content information from whole organisms. Issued Patent, April 2014. Patent number US8,687,857.
- [12] **D. Padfield**, J. Rittscher, A. Can, U. Adiga, E. P. Roquemore, and X. Li. System and method for detecting and eliminating one or more defocused or low contrast-to-noise ratio images. Issued Patent, November 2013. Patent number US8,588,503.
- [13] D. Gao, **D. Padfield**, D. Henderson, K. Kenny, R. McKay, V. Baxi, R. Filkins, and M. Montalto. Image quality assessment including comparison of overlapped margins. Issued Patent, March 2013. Patent number US8,396,269.
- [14] **D. Padfield**, M. Datar, and H. Cline. Segmentation of tissue images using color and texture. Issued Patent, May 2011. Patent number US7,949,181.

- [15] D. Padfield, J. Rittscher, N. Thomas, and T. Sebastian. Time-lapse cell cycle analysis of unstained nuclei. Issued Patent, October 2010. Patent number US7,817,841.
- [16] P. Mendonca, D. Padfield, M. Turek, and J. V. Miller. Edge detection and correcting system and method. Issued Patent, September 2008. Patent number US7,433,086.

## Selected Peer-Reviewed Conference Publications

- [1] K. Cao, D. Padfield, A. Dentinger, K. Wallace, and D. Mills. Robust lumen segmentation in 3D contrast enhanced ultrasound images. In *Proc. IEEE International Symposium on Biomedical Imaging*, pages 659–662, 2015.
- [2] A. Santamaria-Pang, J. Rittscher, M. J. Gerdes, and D. Padfield. Cell segmentation and classification by hierarchical supervised shape ranking. In *Proc. IEEE International Symposium on Biomedical Imaging*, pages 1296–1299, 2015.
- [3] D. Padfield. A fast and memory efficient stationary wavelet transform for 3D cell segmentation. In *Proc. SPIE Medical Imaging*, volume 9413, pages 94133C–94133C–6, 2015.
- [4] D. Padfield, R. Bhotika, and A. Natanzon. FIST: a fast interactive segmentation technique. In *Proc. SPIE Medical Imaging*, volume 9413, pages 941317–941317–5, 2015.
- [5] X. Yang and D. Padfield. Wavelet-initialized 3D level-set cell segmentation with local background support. In *Proc. IEEE International Symposium on Biomedical Imaging*, 2014.
- [6] S. Liu, D. Padfield, and P. Mendonca. Tracking of carotid arteries in ultrasound images. In *Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, volume 8150, pages 526–533, 2013.
- [7] Y. Al-Kofahi, D. Padfield, and A. Seppo. An automated algorithm for cell-level FISH dot counting. In *Proc. SPIE Medical Imaging*, volume 8669, pages 866903–866903–8, 2013.
- [8] X. Liu and D. Padfield. Motion-based segmentation for cardiomyocyte characterization. In *Proc. MICCAI Spatio-temporal Image Analysis for Longitudinal and Time-Series Image Data*, pages 137–146, 2012.
- [9] X. Liu, P. Annangi, M. Gupta, B. Yu, D. Padfield, J. Banerjee, and K. Krishnan. Learning-based scan plane identification from fetal head ultrasound images. In *Proc. SPIE Medical Imaging*, pages 83200A–83200A–6, 2012.
- [10] A. Tuysuzoglu, P. Mendonca, and D. Padfield. Model-based coupled denoising and segmentation of medical images. In *Proc. SPIE Medical Imaging*, pages 83200B–83200B–6, 2012.
- [11] A. Seppo, Y. Al-Kofahi, D. Padfield, T. Ha, N. Jun, A. Kyshtoobayeva, L. Kaanumalle, A. Corwin, D. Henderson, V. Kamath, C. McCulloch, D. Hollman, and KJ Bloom. Automated analysis of Her2 FISH using combined immunofluorescence and FISH signals. In *Cancer Research*, volume 72, December 2012.
- [12] D. Padfield. The magic sigma. In *Proc. IEEE Computer Vision and Pattern Recognition*, pages 129–136, 2011.

- [13] D. Padfield, J. Rittscher, and B. Roysam. Quantitative biological studies enabled by robust cell tracking. In *Proc. IEEE International Symposium on Biomedical Imaging*, pages 1929–1934, 2011.
- [14] J. Rittscher, D. Padfield, A. Santamaria, J. Tu, A. Can, M. Bello, D. Gao, A. Sood, M. Gerdes, and F. Ginty. Methods and algorithms for extracting high-content signatures from cells, tissues, and model organisms. In *Proc. IEEE International Symposium on Biomedical Imaging*, pages 1712–1716, 2011.
- [15] D. Padfield. Masked FFT registration. In *Proc. IEEE Computer Vision and Pattern Recognition*, pages 2918–2925, 2010.
- [16] N. Subramanian, D. Padfield, S. Thiruvenkadam, A. Narasimhamurthy, and S. Frigstad. Automated interventricular septum thickness measurement from B-mode echocardiograms. In *Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, 2010.
- [17] D. Gao, D. Padfield, J. Rittscher, and R. McKay. Automated training data generation for microscopy focus classification. In *Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, 2010.
- [18] D. Gao, D. Padfield, D. Henderson, K. Kenny, and R. McKay. Microscopy image focus quality assessment by overlapping tile analysis. In *Proc. IEEE International Symposium on Biomedical Imaging*, 2010.
- [19] D. Padfield, J. Rittscher, and B. Roysam. Coupled minimum-cost flow cell tracking. In *Proc. Information Processing in Medical Imaging*, 2009.
- [20] D. Padfield and J. Ross. Validation tools for image segmentation. In *Proc. SPIE Medical Imaging*, 2009.
- [21] D. Padfield, J. Rittscher, and B. Roysam. Spatio-temporal cell segmentation and tracking for automated screening. In *Proc. IEEE International Symposium on Biomedical Imaging*, 2008.
- [22] M. Datar, D. Padfield, and H. Cline. Color and texture based segmentation of molecular pathology images using HSOMs. In *Proc. IEEE International Symposium on Biomedical Imaging*, 2008.
- [23] D. Padfield, J. Rittscher, and B. Roysam. Defocus and low CNR detection for cell tracking applications. In *Proc. Microscopic Image Analysis with Applications in Biology*, 2008.
- [24] M. Datar, D. Padfield, and H. Cline. Color and texture based segmentation of molecular pathology images using HSOMs. In *Proc. Microscopic Image Analysis with Applications in Biology*, 2007.
- [25] D. Padfield, G. Brooksby, and R. Kaucic. Automatic deformation detection for visual post inspection. In *IEEE Workshop on Applications of Computer Vision*, 2007.
- [26] D. Padfield, J. Rittscher, N. Thomas, and B. Roysam. Spatio-temporal cell cycle phase analysis using level sets and fast marching methods. In *Proc. Microscopic Image Analysis with Applications in Biology*, 2006.
- [27] D. Padfield, J. Rittscher, N. Thomas, and B. Roysam. Validation methods for cell cycle analysis algorithms in confocal fluorescence images. In *Proc. IEEE/NLM Life Science Systems and Applications Workshop*, 2006.

- [28] **D. Padfield**, J. Rittscher, T. Sebastian, N. Thomas, and B. Roysam. Spatio-temporal cell cycle analysis using 3D level set segmentation of unstained nuclei in line scan confocal fluorescence images. In *Proc. IEEE International Symposium on Biomedical Imaging*, 2006.
- [29] **D. Padfield** and R. Manjeshwar. Adaptive conductance filtering for spatially varying noise in PET images. In *Proc. SPIE Medical Imaging*, 2006.
- [30] H. Cline, A. Can, and **D. Padfield**. Segmentation of prostate cancer tissue micro array images. In *SPIE Biomedical Optics*, 2006.
- [31] P. R. S. Mendonça, **D. Padfield**, J. C. Ross, J. V. Miller, S. Dutta, and S. Mal Gautham. Quantification of emphysema severity by histogram analysis of CT scans. In *Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, pages 738–744, 2005.
- [32] P. R. S. Mendonça, **D. Padfield**, J. V. Miller, and M. Turek. Bias in the localization of curved edges. In *Proc. European Conference on Computer Vision*, pages 554–565, 2004.
- [33] W. E. Higgins, J. P. Helferty, and **D. Padfield**. Integrated broncoscopic video tracking and 3D CT registration for virtual bronchoscopy. In *Proc. SPIE Medical Imaging*, volume 5031, pages 80–89, 2003.