Fredrick E. Park

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Education

- **Doctor of Philosophy in Applied Mathematics**
  University of California, Los Angeles
  Graduation: *August 2006*
  Thesis Title: *Total Variation and Duality for Blind Image Deconvolution, Staircase Reduction, and Texture Extraction*
  Thesis advisor: Tony F. Chan
- **Master of Arts** (Mathematics), UCLA *2000*
- **Bachelor of Science** (Mathematics), UCLA *1997*
  Cum Laude, College Honors and High Honors in Mathematics

Professional Experience

Associate Professor, Whittier College, *2018–*
(Tenure approved Feb. 2018, effective Sept. 2018)

Lecturer, Master of Finance Program, Paul Merage School of Business, University of California at Irvine, *Winter 2019–*

Visiting Associate Researcher, University of California at Irvine, *Fall 2018–Spring 2019*, Host: Jack Xin

Assistant Professor, Whittier College, *2012–2018*

Visiting Researcher, University of California at Irvine, *Summer 2013*, Mentor: Jack Xin

Associate Research Scientist Level V (Researcher and Lecturer), University of California at Irvine, *2011–2012*, Mentors: Hongkai Zhao and Jack Xin

Postdoctoral Scholar and Lecturer, University of California, Irvine, *2009–2011*, Mentor: Hongkai Zhao

Assistant Adjunct Professor, University of California, Los Angeles, *2007–2009*

Postdoctoral Assistant Professor, University of Michigan, Ann Arbor, *2006–2007*, Mentor: Selim Esedoglu

Research Interests

Data Science: Machine Learning, Computer Vision, Mathematical Image Processing, and Scientific Computing
Sparsification of Deep Convolutional Neural Networks. Variational shape prior image segmentation, disocclusion, and capture of illusory contours. Object and real time face tracking. Non-convex penalty optimization. Surface reconstruction from unorganized point cloud data. Image analysis and modeling using geometric, functional, and PDE based methods for geometry preserving image denoising, blind deconvolution, inpainting, texture extraction, and staircase reduction. In addition, development of fast and stable numerical methods including primal dual and high order duality based methods.

Publications

- *Convergence Analysis for Difference of Convex Algorithms Applied to Weighted Differences of Anisotropic and Isotropic Total Variation with Applications to Multi-phase Image Segmentation and Data Clustering*, In preparation (with K. Bui, J. Xin, and Y. Lou).
- *Difference of Convex Regularized Structured Sparsity Deep Convolutional Neural Networks*, In preparation (with J. Householder, K. Bui, S. Zhang, Y. Qi, and J. Xin).

- *Feature Map Augmentation for Deep Convolutional Neural Networks*, In preparation (with J. Householder).
- *Relaxed Variable Splitting L_p Regularized Group Sparsity Deep Convolutional Neural Networks*, In preparation (with K. Bui, S. Zhang, Y. Qi, and J. Xin).
- *Radon Histogram Based Shape Prior Segmentation and Disocclusion Utilizing the Level Set Method*, In preparation.
- *L_0 Regularized Structured Sparsity Convolutional Neural Networks*, Submitted. (with K. Bui, S. Zhang, Y. Qi, and J. Xin).
- *Geodesic Active Contours with Shape Priors for Disocclusion and Illusory Contour Capture*, Submitted (with J. Householder).
- *A Weighted Difference of Anisotropic and Isotropic Total Variation for Relaxed Mumford-Shah Image Segmentation*, In Proceedings. IEEE International Conference on Image Processing (ICIP), Sept. 25-28th, Phoenix Arizona, USA, 2016. DOI: 110.1109/ICIP.2016.7533174 (with J. Xin and Y. Lou).
- *Image Segmentation Using Clique Based Shape Prior and the Mumford Shah Functional*, In Proceedings. IEEE International Conference on Image Processing (ICIP), Sept. 27-30th, Quebec City, Canada, 2015. DOI: 10.1109/ICIP.2015.7351572 (Recognized as part of the Top 10% papers in ICIP 2015).
- *Parallelization of a Color-Entropy Preprocessed Chan-Vese Model for Face Contour Detection on Multi-Core CPU and GPU*, Parallel Computing, August 2015, pp. 28-49. DOI: 10.1016/j.parco.2015.07.002 (with X. Shi, L. Wang, J. Xin, and Y. Qi).
(http://www.sciencedirect.com/science/article/pii/S0167819115001052)
- *Robust and Efficient Implicit Surface Reconstruction for Point Clouds Based on Convexified Image Segmentation*, Journal of Scientific Computing, vol. 54, issue 2-3, pgs. 577-602, Feb. 2013. DOI: 10.1007/s10915-012-9674-8 (with J. Liang and H. Zhao).
- *Feature Identification for Colon Tumor Classification*, SIAM Undergraduate Research Online (SIURO) vol. 6, 2013. http://dx.doi.org/10.1137/13S012212. Undergraduate Research Publication (with M. Lim, A. Hou, N. Congdon, J. Chua, E. Esser, and A. Konstorum).
- *A Fourth Order Dual Method for Staircase Reduction in Texture Extraction and Image Restoration Problems*, In Proceedings. IEEE International Conference on Image Processing (ICIP), Hong Kong, pgs. 4137-4140, 2010. DOI: 10.1109/ICIP.2010.5653199 (with T. F. Chan and S. Esedoglu).
- *Image Decomposition Combining Staircase Reduction and Texture Extraction*, Journal of Visual Communication and Image Representation, vol. 18, issue 6, pgs. 464-486, 2007. (with T. F. Chan and S. Esedoglu).
- *Recent Developments in Total Variation Image Restoration.* In "Handbook of Mathematical Models in Computer Vision", Chapter 2, pgs. 17-32. Springer Verlag, 2005. Edt. by: N. Paragios, Y. Chen, O. Faugeras. (with T. F. Chan, S. Esedoglu, and A. Yip).
- *Simultaneous Total Variation Image Inpainting and Blind Deconvolution*, International Journal of Imaging Systems and Technology, vol. 15:1, pgs 92-102, 2005. (with T. F. Chan and A. Yip).

Technical Reports

- *Data Dependent Multiscale Total Variation Based Image Decomposition and Contrast Preserving Denoising*, UCLA CAM Report 04-15, March 2004. (with T. F. Chan).
- *Solution Dynamics, Causality, and Critical Behavior of the Regularization Parameter in Total Variation Denoising Problems*, UCLA CAM Report 03-59, November 2003. (with A. Yip).

Invited/Conference Presentations

- *AMS Sectional Meeting*
  UC Riverside, California, USA. *November 9th, 2019*
  30 minute talk: Mentoring Undergraduates in Applied Mathematics and Computer Science Research
- *UC Irvine Computer Science AI/ML Seminar*
  Irvine California, USA. *November 5th, 2018*
  50 minute talk: Image Segmentation and Tracking Utilizing a Difference of Convex Regularized Mumford-Shah Functional
- *IEEE International Conference on Image Processing (ICIP)*
  Phoenix Arizona, USA. *September 25th-28th, 2016*
  Poster Presentation: A Weighted Difference of Anisotropic and Isotropic Total Variation for Relaxed Mumford-Shah Image Segmentation
- *IEEE International Conference on Image Processing (ICIP)*
  Quebec City, Canada. *September 27th-30th, 2015*
  Poster Presentation: Image Segmentation Using Clique Based Shape Prior and the Mumford Shah Functional
- *IEEE International Conference on Image Processing (ICIP)*
  Quebec City, Canada. *September 27th-30th, 2015*
  Show & Tell Demo: Shape Prior Image Segmentation and Disocclusion
- *IEEE International Conference on Image Processing (ICIP)*
  Hong Kong, *September 26th-29th, 2010*
  20 minute talk: A Fourth Order Dual Method for Staircase Reduction in Texture Extraction and Image Restoration Problems
- *Computational Modeling of Objects Represented in Images*
  Fundamentals, Methods, and Applications (CompImage)
  Coimbra, Portugal, *October 20th-21st, 2006*
  Forty five minute talk: High Order Dual Methods for Staircase Reduction in Texture Extraction Problems
- *2006 SIAM Conference on Imaging Science*
  Minneapolis, Minnesota, *May 15-17, 2006*
  Twenty five minute talk: A Fourth Order Dual Method for Staircase Reduction in Texture Extraction and Image Restoration Problems
- *Southern California Applied Mathematics Symposium (SoCAMS)*
  University of Southern California (USC), *April 24th, 2005*
  Poster Presentation: Image Decomposition Combining Staircase Reduction and Texture Extraction
- *BIRS Workshop, Mathematical Image Analysis and Processing*
  Banff International Research Station (BIRS), Alberta, Canada, *October 23-28, 2004*
  Forty five minute talk: Simultaneous Total Variation Image Inpainting and Blind Deconvolution
- *Southern California Applied Mathematics Symposium (SoCAMS)*
  Harvey Mudd College, *April 24th, 2004*
  Poster Presentation: Data Dependent Multiscale Total Variation Based Image Decomposition and Contrast Preserving Denoising

Responsibilities

Pi Mu Epsilon (PME) Math Honor Society Advisor, Whittier College, *2013-2018, 2019–*
Responsibilities include: Organizing the annual PME initiation ceremony, inviting guest speakers, and obtaining funding for PME.

Math Club Advisor, Whittier College, *2013-2018*
Responsibilities include: Organizing events, talks, and facilitating the procurement of funding for these activities.

Keck Research Fellowship Advisor, Whittier College, *Summer 2019*
Responsibilities include: Formulating and conducting research with mentor Jacob Householder on deep learning.

HHMI SMART Fellowship Advisor, Whittier College, *2014-2015*
The Howard Hughes Medical Institute (HHMI) funded Science and MAth in Research and Teaching (SMART) Program
Responsibilities include: Formulating and conducting research with mentor Rachel Tegenkamp on machine learning methods for modeling traffic flow.

Team Lead: UCI iCAMP Program for the Malignant Tumor Classification Group, UCI, *Summer 2012*
Responsibilities include: Team lead for 3 undergraduate research students and 1 advanced HS student for the UCI Interdisciplinary Computational and Applied Mathematics Program (iCAMP). Duties include organizing and structuring program for the Malignant Tumor Classification group, lecturing and administering tutorials on shape modeling and classification, suggesting and overseeing research projects, training and mentoring students in research.
Explicit contributions include: processing in vitro malignant tumor data and learning descriptive features from the data that will aid cancer researchers in detecting dispersive tumors and rate of dispersion using machine learning techniques.
Outcome: National level undergraduate conference presentation talk and poster at the MBI Ohio State Undergraduate Research Capstone Conference (August 13-17, 2012) and publication in SIURO. *see*: *http://mbi.osu.edu/eduprograms/upcapstone.html* and *http://math.uci.edu/icamp/summer/research/*

Team Lead: UCI iCAMP Program for the Shape Classification Group, UCI, *Summer 2011*
Responsibilities include: Team lead for 6 undergraduate research students and 1 advanced HS student for the UCI Interdisciplinary Computational and Applied Mathematics Program (iCAMP). Duties include organizing and structuring program for the shape classification group, lecturing and administering tutorials on shape modeling and classification, suggesting and overseeing research projects, training and mentoring students in research.
Explicit contributions include: designing/utilizing shape descriptors and machine learning algorithms for applications in shape classification, cancer cell clustering, and cancer cell detection/classification. *see: http://math.uci.edu/icamp/summer/research/*

Organizer of the UCI Image Processing and Learning Seminar, UCI, *Fall 2009–Fall 2012*
Responsibilities include: organization of the biweekly group meetings, special talks, activities, and the recruitment of guest speakers.

Coordinator of Tony F. Chan's Research Group, UCLA, *Summer 2002–Winter 2005*
Responsibilities include: organization of the weekly group meetings, special talks, activities, and the recruitment of guest speakers.

Senior Thesis Advising

- Anastasia Bergara: *Variational Image Segmentation Utilizing the Chan Vese Model with Applications to Medical Imaging*
- Crystabel Camacho: *Image Deblurring Using the Backward Heat Equation*
- Callie Mitchell: *Image Denoising by Non-local Means*
- Patrick Hagman: *Nonlinear Conjugate Gradient Method and Non-linear Regression with Applications to Pokemon*
- Lauren Gandi: *Variational Image Super-Resolution*
- Ann Bailleul: *Machine Learning with Linear Regression, Logistic Regression, and Applications*
- Julian Droetti: *Deep Neural Networks and Applications*

Journal Referee

- IEEE Transactions on Image Processing
- Inverse Problems in Imaging
- Mathematical Problems in Engineering
- International Journal of Applied and Computational Mathematics
- Nonlinear Analysis Series B: Real World Applications

Funding History

NSF Preparation for Industrial Careers in the Mathematical Sciences (PIC Math) Grant, 2019-2020. Award: $4000.00.

Faculty Research and Development Grant, Whittier College, 2015. Award: $849.38. For Computational Math Software.

Faculty Research and Development Grant, Whittier College, 2016. Award: $786.28. For Computational Math Software and Computer.

Faculty Research and Development Grant, Whittier College, 2019. Award: $4000.00. For GPU Deep Learning Machine.

Awards

Robert Sorgenfrey Distinguished Teaching Award, UCLA Postdoctoral Award for Teaching Excellence, *Spring 2009*

Ranked #11 Overall in Teaching at UCLA, UCLA Bruinwalk Professor Evaluation Site, #11 overall for the entire UCLA campus across all different academic disciplines. *Sept 2011–Sept. 2014*

Research Assistantship, *Winter 2004-Summer 2006*
Supported by research grants from the ONR under contracts N00014-03-1-0888 and N00014-96-1-0277, the NIH under contracts U54 RR021813 and MH65166, and the NSF under contract DMS-9973341.

Daus Prize, UCLA Undergraduate Award in Mathematics, *Spring 1997*

Courses Taught

Machine Learning (Whittier College, Spring 2020)

Industrial Problems in the Mathematical Sciences (Whittier College, Spring 2020)

Programming and Data Analysis for Business (UCI Paul Merage School of Business)

AI, Computer Vision, and Cognition (Whittier College)

Data Structures in C++ (Whittier College)

Intro to Computer Science using Python (Whittier College)

Mathematical Modeling (Whittier College)

Quantitative Reasoning (Whittier College)

Honors Applied Calculus (Umich Ann Arbor)

Numerical Methods/Analysis (Umich Ann Arbor, Whittier College)

Single Variable Calculus (UCLA, Whittier College)

Vector Calculus (UCLA, UCI, Whittier College)

Linear Algebra and Applications (UCLA, Whittier College)

Nonlinear Ordinary Differential Equations (UCLA)

Ordinary Differential Equations (UCI, Whittier College)

Shape Representation and Classification Tutorial (UCI)

Undergraduate Independent Research (UCLA and UCI)

References

Tony F. Chan
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Professor of Mathematics at UC Irvine
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Hongkai Zhao
Chancellor's Professor Mathematics Department at UC Irvine
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Selim Esedoglu
Associate Professor of Mathematics at the University of Michigan, Ann Arbor
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Personal Information

Citizenship: USA

Knowledge of spoken Korean and Spanish & written Spanish and French

Surfing and Martial Arts Enthusiast

Food and Wine Devotee