

# Arash Abadpour

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**Machine Vision Scientist proficient in Machine Learning with 10+ years of experience in disruptive Canadian companies.**

I am enthusiastic about systems that survive, be it a living organism that evolves and adapts to the changing environment or an algorithm that is robust against noise and the unseen. I have a Ph.D. in Electrical Engineering, and I have indeed worked as an Electrical Engineer in the past, yet the best thing that I am capable of doing, and love doing, and have been grappling with in the past 10+ years, is designing systems that distantly resemble human cognition, especially in the fields of Machine Vision and visual perception. That effort has resulted in 10+ patents, 10+ journal papers, a stable and growing career, and, most importantly, the passion and conviction that General Intelligence will be constructed by mankind before I stop breathing. I love books and films and music and I am interested in writing, both for silicon machines as well as flesh ones. I am an amateur digital arts hobbyist and I am fascinated by the Socratic method. Life is too precious for work to be a mere survival mechanism.

More information and the full text of patents and publications are available at <http://abadpour.com>.

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## Industry Experience

### **Machine Learning,**

- *Classifier design and productization in hyper-dimensional settings.*
- *Neural Network training and deployment, including Convolutional Neural Networks.*
- *Ground-truth data collection and tagging as the back-end for training and evaluation of ML utilizing AWS.*
- *Offline ML training orchestration on a cluster of loosely-connected machines.*
- *Traceability management for data and models in order to satisfy regulatory requirements.*
- *On-the-device deployment of ML algorithms, given processing power, execution time, and battery consumption requirements.*
- *User interface design for ML algorithms, for the purposes of data tagging, problem specification, and assessment of the results.*
- *Deployment management, including model transfer to the production pipeline.*

**Image Processing,**

- *General image processing, including grayscale, color, infrared, and depth image processing.*
- *Image processing for robotics applications, including pose estimation, camera calibration, and stereo processing.*
- *Bilateral and trilateral filtering for the purposes of noise removal and interpolation.*

**Machine Vision,**

- *3D object detection using mono and stereo camera systems.*
- *3D object pose estimation using low and high level features and training data collected on real or CAD data.*
- *Bin picking using a robotic arm.*
- *Visual inspection of output of printing processes as well as fidelity of manufactured parts.*

**Photogrammetry,**

- *Fiducial-based pose estimation, including utilizing available technologies such as ARToolKit and ARTag, as well as designing in-house solutions.*
- *NIR-domain tracking for the purpose of sub-millimeter and sub-degree 6 DoF pose estimation.*

**Medical Image Processing,**

- *DICOM import and processing.*
- *Geometric modeling of organs using MRI slices.*
- *Sterile-field processing for the purpose of surgical navigation.*

**Optimization,**

- *Inverse problem-based parameter estimation using least mean square and Levenberg-Marquardt minimization.*
- *Stochastic optimization in the presence of outliers using RANSAC and robustified cost minimization.*
- *Fuzzy modeling of multi-layer systems, especially within the field of pattern recognition, using Bayesian models.*

**Range-Data Processing,**

- *Data acquisition and calibration of depth sensors, including stereo, structured light and Time of Flight (ToF) sensors.*
- *RGBD filtering using bilateral and trilateral filtering pipelines.*
- *Depth fusion between multiple depth sources as well as between a depth source and a raster image sensor.*
- *Multi-sensor depth registration utilizing both 3D and 2D features and different variations of the Iterative Closest Point (ICP) algorithm.*
- *Depth up-sampling and noise-reduction.*

**Human-Machine Interface,**

- *Data acquisition and calibration of augmented and virtual reality systems.*
- *3D scan/display systems utilizing multiple depth sensors.*

### **Pattern Recognition,**

- *Cost function derivation using Bayesian Inference for the purpose of clustering and modeling.*
- *Unsupervised clustering using FCM, PCM, FPCM, and other variants.*
- *Extensive research on the stability of fuzzy clustering models.*
- *Principal Component Analysis (PCA) for color classification, including skin detection and color image segmentation.*

### **Symbolology,**

- *Symbology detection and interpretation, using available technologies as well as designing in-house solutions.*

### **Computational Photography,**

- *Color transfer between color images and color video sequences.*
- *Colorization of available grayscale image and video sequences using other color content.*

### **Image Data Management,**

- *Visual watermarking and data hiding using redundancy in the spectral domain.*

### **Inertial Data Processing,**

- *Accelerometer data processing for the purpose of validation and augmentation of optical systems.*

Items in this list refer to tasks completed in previous employments or in the academia. Further details will be provided upon request, subject to NDA limitations.

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## **Education**

- 2005–2009 **Ph.D.**, *University of Manitoba, Canada.*  
Electrical and Computer Engineering Department
- 2003–2005 **Master of Science**, *Sharif University of Technology, Iran.*  
Mathematics Science Department, Computer Science Group (Scientific Computation)
- 1996–2003 **Bachelor of Science**, *Sharif University of Technology, Iran.*  
Electrical Engineering Department, Control Group
- 1992–1996 **High school**, *Exceptional Talents High School, Iran.*  
Diploma in Physics and Mathematics

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## **Certifications**

- 2018 (Ongoing) **Deep Learning Specialization**, *Five-Course Specialization.*  
By Andrew Ng (deeplearning.ai)
- 2017 **Neural Networks for Machine Learning.**  
By University of Toronto on Coursera
- 2017 **Machine Learning.**  
By Stanford University on Coursera

- 2017 **Machine Learning**, *Four-Course Specialization*.  
By University of Washington on Coursera
- 2013 **Patents**, *Understanding Patents - An Introductory Course*.  
McGill University School of Continuing Studies

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## Patents

*"System, method and/or computer readable medium for non-invasive workflow augmentation"*, WO Application Number WO2018094534A1, Priority Date 26 November 2016.

*"System, method and/or computer-readable medium for identifying and/or localizing one or more rapid diagnostic tests"*, WO Application Number WO2018094533A1, Priority Date 26 November 2016.

*"Visual pattern recognition system, method and/or computer-readable medium"*, WO Application Number WO2018094532A1, Priority Date 26 November 2016.

*"Systems and methods for tracker characterization and verification"*, US Application Number US20170345177A1, Priority Date 27 May 2016.

*"Systems, methods and devices to scan 3d surfaces for intra-operative localization"*, International Publication Number WO2017185170A1, Priority Date 28 April 2016.

*"Method for object pose estimation, apparatus for object pose estimation, method for object estimation pose refinement and computer readable medium"*, Japanese Patent JP2013050947A, Publication Date 19 October 2016.

*"HMD Calibration with Direct Geometric Modeling"*, US Patent US20160012643A1, Publication Date 14 January 2016.

*"HMD Calibration with Direct Geometric Modeling"*, EU Patent No. 15175799.4 - 1902, Filing Date 8 July 2015.

*"System generating three-dimensional model, method and program"*, Japanese Patent JP2015176600A, Publication Date 5 October 2015.

*"Holocam Systems and Methods"*, US Patent US20150261184, Publication Date 17 September 2015.

*"Method and Apparatus for Improved Training of Object Detecting System"*, US Patent US20140079314, Publication Date 20 March 2014.

*"Method for simulating impact printer output, evaluating print quality, and creating teaching print samples"*, US Patent 8654398, Publication Date 18 February 2014.

*"Method and apparatus for object pose estimation"*, US Patent 8467596, Publication Date 18 June 2013.

Declassified titles of additional patents will be posted upon the completion of the patenting pro-

cedure.

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## Professional Experience

- 2016–Current **Senior Scientific Developer**, *Fio Corporation, Toronto, Canada*.  
Utilization of Machine Learning algorithm for the purpose of visual identification and analysis of Rapid Diagnostics Tests (RDT) for infectious diseases such as HIV, Malaria, Dengue, and others.
- 2015–2016 **Research Scientist**, *Intellijoint Surgical, Waterloo, Canada*.  
Research on surgery-assistance products which utilize machine vision in order to carry out and confirm geometrical measurements.
- 2009–2015 **Researcher**, *Imaging Group, Epson Canada Limited, Toronto, Canada*.  
Conduct research and recommend solutions for problems in the fields of Visual Inspection, Symbology Detection, 3D Object Detection and Pose Estimation, Camera Calibration, Augmented and Virtual Reality, 3D Scan/Display Systems.
- 2001–2004 **Process Control Engineer**, *Karband Eng. Co., Tehran, Iran*.  
Responsible for design, implementation and erection of PLC-based control systems for medium-sized machinery in pipe and profile production plants.
- 1998–2009 **Research Assistant**, *University of Manitoba, Telecommunications Research Laboratories (TRLabs) Winnipeg and Biomechanics Laboratory, Sharif University of Technology*.  
Conduct research on projects related to Network Optimization, Earthquake Damage Detection using Satellite Imagery, Human Gait Analysis, 3D Surface Reconstruction, Color Image Processing with Applications in Watermarking, Encryption, Compression, Color Transfer, Grayscale Image Colorization, and Pornography Detection.
- 2005 **University Instructor**, *Shariati University*.  
Digital Image Processing (Undergraduate Course).
- 2004–2007 **Teacher's Assistance**, *University of Manitoba and Sharif University of Technology*.  
For Advanced Digital Image Processing (Graduate Course), Digital Control, and Communication Systems (Undergraduate Courses).

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## Technical Skills

**Python**, *Python 2, Python 3, PyQt, PyMySQL, OpenCV, NumPy, SciPy, Matplotlib, scikit-learn, TensorFlow, Caffe*.

**C/C++**, *C++11, Visual Studio, QT, OpenCV*.

**MATLAB**, *C/MEX, Object-Oriented Programming, Matlab Compiler, Matlab Engine, OpenCV, Image Processing Toolbox, Optimization Toolbox, Matlab GUI, Octave*.

**Windows**, *Batch Programming*.

**Linux**, *Bash Programming, Raspbian*.

**Web Programming**, *php, RSS.*

**Database**, *MySQL, Amazon RDS, phpMyAdmin.*

**Software Development**, *Agile Development, JIRA, git.*

**Hardware**, *Raspberry Pi, General Electronics, General Digital Electronics, General Circuits.*

**Patents**, *Keyword Creation, Patent Search, Patent Review, Invention Disclosures and Algorithm Description.*

**Other**, *L<sup>A</sup>T<sub>E</sub>X, POV-Ray, IVT, PCL, CImg, OpenGL, Armadillo, Gandalf, Ceres Solver, and other open-source tools.*

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## Selected Publications

**Ph.D. Thesis**, *QoS-Constrained Information Theoretic Capacity Maximization in CDMA Systems*, Electrical and Computer Engineering Department, University of Manitoba, Winnipeg, Manitoba, Canada, Supervised by Prof. Attahiru Sule Alfa (Ph.D.), 2005–2009.

**M.Sc. Thesis**, *Color Image Processing using Principal Component Analysis*, Mathematics Science Department, Sharif University of Technology, Tehran, Iran, Supervised by Shohreh Kasaei (Ph.D.) and A. Daneshgar (Ph.D.), 2004–2005.

**Journal Paper**, *Incorporating spatial context into fuzzy-possibilistic clustering using Bayesian inference*, Arash Abadpour, Journal of Intelligent and Fuzzy Systems, Accepted for Publication, August 2015..

**Journal Paper**, *A Sequential Bayesian Alternative to the Classical Parallel Fuzzy Clustering Model*, Arash Abadpour, Information Sciences, Volume 318, October 2015, Pages 28–47..

**Journal Paper**, *On Applications of Pyramid Doubly Joint Bilateral Filtering in Dense Disparity Propagation*, Arash Abadpour, 3D Research, Volume 5, Issue 2, 25 April 2014, Pages 1–20.

**Journal Paper**, *Color PCA Eigenimages and Their Application to Compression and Watermarking*, Arash Abadpour and Shohreh Kasaei, IEE Image & Vision Computing, Volume 26, Issue 7, July 2008, Pages 878–890.

**Journal Paper**, *Closed Form Solution for Maximizing the Sum Capacity of Reverse-Link CDMA System with Rate Constraints*, Arash Abadpour, Attahiru Sule Alfa, and Anthony C.K. Soong, IEEE Transactions on Wireless Communications, Volume 7, Issue 4, April 2008, Pages:1179–1183.

**Journal Paper**, *Video-on-Demand Network Design And Maintenance Using Fuzzy Optimization*, Arash Abadpour, Attahiru Sule Alfa, and Jeff Diamond, IEEE Transactions on Systems, Man, and Cybernetics, Part B, April 2008, Volume 38, Issue 2, Pages: 404–420.

**Journal Paper**, *Unsupervised, Fast and Efficient Color Image Copy Protection*, Arash Abadpour and Shohreh Kasaei, IEE Proceedings Communications, October 2005, Volume 152, Issue 5, Pages 605–616.

Detailed list can be found in the full version of this resume or at <http://abadpour.com>.

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## Select Honors & Awards

- 2005–2009 **Ph.D. Scholarship**, *Telecommunication Research Labs (TRLabs), Winnipeg (Total of \$72,000)..*
- 2006–2007 **Ph.D. Fellowship**, *Edward R. Toporeck Graduate Fellowship in Engineering and University of Manitoba International Graduate Student Scholarship (IGSS) (Total of \$9,288)..*
- 2002 **Achievements during the Masters of Science Studies**, *5th Place in the National M.Sc. Examination for Computer Engineering (Artificial Intelligence), 11th Place in the National M.Sc. Examination for Computer Sciences, 4th Place in the 7-th National Scientific Olympiad for Masters Students, papers praised in different conferences..*
- 1995–1996 **High School Achievements**, *Awarded two Silver Medals in the Iranian National Mathematics and Computers Olympiads. Given the 234th highest ranking in the Iranian National University Entrance Examination among 500,000 participants (estimated number)..*

***References are available upon request.***

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