

Nima Najmaei

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Areas of Expertise: Control System Design and Applications, Robotics, Haptics and Telerobotics, Surgical Robotics, Mechanical Design, Prototyping, Modeling and Estimation, Sensor Data Fusion

Education

PhD, Electrical and Computer Engineering **September 2009 – December 2014**
University of Western Ontario **London ON, Canada**

Thesis Title: Design of a Haptic Interface for Medical Applications using Magneto-Rheological Fluid Based Actuators
NSERC CREATE Computer-Aided Medical Interventions (CAMI) Program Scholar
Supervisors: Prof. Rajni V. Patel and Prof. Mehrdad R. Kermani, Average: 95/100

MESc, Electrical and Computer Engineering **September 2007 – August 2009**
University of Western Ontario **London ON, Canada**

Thesis Title: Pre-Collision Safety Strategies for Human-Robot Interactions
Supervisor: Prof. Mehrdad R. Kermani, Average: 94/100

BASc, Electrical and Control Engineering **September 2002 – December 2006**
Shiraz University **Shiraz, Fars, Iran**

Final Project: Design & Construction of a Sonar-based Mobile Robot
Graduated with Distinction, Average: 17.65/20

Experiences

Robotics Research Fellow (Rehabilitation Technologies) **September 2015 – Present**
AIRR, Toronto Rehabilitation Institute, University Health Network
Working toward commercialization of a robotics-assisted rehabilitation platform for stroke therapy of upper limb

Graduate/Doctoral Researcher **September 2009 – February 2015**
Canadian Surgical Technologies and Advanced Robotics (CSTAR)
Research on Haptics, Smart Actuators, Surgical Robotics

Graduate Researcher **September 2007 – August 2009**
Faculty of Engineering, University of Western Ontario
Research on Human Robot Interaction, Safe Human Robots, Industrial Robots

Teaching Assistant **September 2007 – August 2014**
Faculty of Engineering, University of Western Ontario
Teaching Assistant for Undergraduate Courses, Lab Coordinator, Design of Lab Manuals and Experiments

Research Assistant (Part-Time) **September 2006 – August 2007**
Shiraz University
Research on Congestion Control in Large Computer Networks

Junior Automation Engineer **January 2006 – April 2007**
Homayoun Electric Ltd.
Shiraz Fars, Iran

Networking Consultant (Part-Time) **January 2005 – December 2005**
Pourab Co.
Shiraz Fars, Iran

System Analyst and Database Administrator **September 2004 – August 2005**
AsiaMehrKav Co.
Shiraz Fars, Iran

English Language Instructor **January 2004 – April 2005**
Shiraz University Language Center
Shiraz Fars, Iran

Honors and Awards (National and Provincial)

- Mitacs Accelerate Program (held at TRI and Quanser, \$55K), 2015-16
- Ontario Graduate Scholarship (OGS, \$15K), 2012-13
- Queen Elizabeth II Scholarship in Science and Technology (Declined, \$15K), 2012-13
- NSERC Alexander Graham Bell Canada Graduate Scholarship (\$105K), 2009-12

Honors and Awards (Others)

- Outstanding Presentation Award in Western ECE Graduate Symposium, 2013
- NSERC CREATE CAMI Program stipend Scholarship (\$15K), 2012-13
- Western GTA Union Academic Achievement Scholarship (\$500), 2012
- Western Engineering Stipend Scholarship (\$10.2K/y), 2009-12
- Western GTA Union Outstanding Research Contributions Scholarship (\$400), 2011
- Western Graduate Thesis Research Award (GTRA, \$750), 2011
- NSERC CAMI Program Supplementary Funds (Declined, \$10K), 2009-10
- Western ECE Department Travel Grant (\$500), 2010
- Western Graduate Thesis Research Award (GTRA, \$750), 2010
- Western ECE Department Travel Grant (\$500), 2009
- UBC ICICS, GSI, and APSC NSERC Top-Up Scholarships (Declined), 2009
- UBC Mechanical Eng. PhD Admission plus Entrance Scholarship (Declined), 2009
- UBC Electrical Eng. PhD Admission plus NSERC Top-Up (Declined), 2009
- UBC Mechanical Engineering Top Graduate Applicants Travel Grant (\$750), 2009
- Western Graduate Thesis Research Award (GTRA, \$750), 2009
- Western Graduate Research Scholarship (WGRS, \$17.5K/y), 2007-09
- Western Graduate Thesis Research Award (GTRA, \$750), 2008
- Western Engineering Graduate Entrance Scholarship (WEGES, \$3K), 2007
- Third place in Annual Iranian Students Research Competition, 2007
- Graduated with distinction from Shiraz University, Faculty of Engineering, 2006

Publications

Thesis

- **Najmaei N.**, Design of a Haptic Interface for Medical Applications using Magneto-Rheological Fluid Based Actuators, PhD Thesis, Faculty of Engineering, University of Western Ontario, Dec 2014
- **Najmaei N.**, Pre-Collision Safety Strategies for Human-Robot Interactions, MSc Thesis, Faculty of Engineering, University of Western Ontario, Aug 2009

Peer-Reviewed Book Chapters

- **Najmaei N.**, Kermani M.R., Pre-Collision Planning and Control Strategies for Physical Human-Robot Interactions, New Development of Manufacturing Robotic Systems, Bentham Science, ISBN: 978-1-60805-281-3, 2011

Peer-Reviewed Journal Papers

- **Najmaei N.**, A. Asadian, Kermani M.R., Patel R.V., Design and Performance Evaluation of a Prototype MRF-based Haptic Interface for Medical Applications, IEEE/ASME Transactions on Mechatronics, in press, Accepted April 2015
- **Najmaei N.**, Kermani M.R., Patel R.V., Suitability of Small-Scale Magneto-Rheological Fluid Based Clutches in Haptic Interfaces for Improved Performance, IEEE/ASME Transactions on Mechatronics, in Press, 2014

- Azizian M., **Najmaei N.**, Khoshnam M., Patel R.V., Visual Servoing in Medical Robotics; Part II: Tomographic Imaging Modalities: Techniques and Applications, International Journal of Medical Robotics and Computer-Assisted Surgery, In press, Accepted Jan 2014
- Azizian M., Khoshnam M., **Najmaei N.**, Patel R.V., Visual Servoing in Medical Robotics; Part I: Endoscopic and Direct Vision Imaging: Techniques and Applications, International Journal of Medical Robotics and Computer-Assisted Surgery, Accepted Aug 2013
- **Najmaei N.**, Azizian M., Mostafavi S.K., Shahbazi S., Image-Guided Techniques in Hepatic and Renal Interventions, International Journal of Medical Robotics and Computer-Assisted Surgery, June 2012
- **Najmaei N.**, Kermani M.R., Al-Lawati M., A New Sensory System for Modeling and Tracking Human Motions within the Robotic Workcell, IEEE Transactions on Instrumentation & Measurement, Vol. 60(4), pp. 1227-1236, April 2011
- **Najmaei N.**, Kermani M.R., Applications of Artificial Intelligence in Safe Human-Robot Interaction, IEEE Transactions on Systems, Man, & Cybernetics, Part B, Vol. 41(2), pp. 448-459, April 2011
- **Najmaei N.**, Kermani M.R., On Superquadric Human Modeling and Risk Assessment for Safe Planning of Human-Safe Robotic Systems, ASME J of Mechanisms and Robotics, Vol. 2(4), Nov 2010
- **Najmaei N.**, Kermani M.R., A Streamlined Search Algorithm for Path Modifications of a Safe Robot Manipulator, Paladyn Journal of Behavioral Robotics, Vol. 1(2), pp. 130-140, June 2010
- Shames I., **Najmaei N.**, Zamani M., Safavi A., A New Intelligent and Adaptive Traffic Shaper for High Speed Networks, Int Journal of Information Science & Technology, Vol. 5(2), pp. 67-82, July 2007

Peer-Reviewed Conference Papers

- **Najmaei N.**, Asadian A., Kermani M.R., Patel R.V., Performance Evaluation of Magneto-Rheological Based Actuation for Haptic Feedback in Medical Applications, to appear in IEEE International Conference on Intelligent Robots and Systems, Hamburg Germany, Sep 28 - Oct 2 2015
- **Najmaei N.**, Asadian A., Kermani M.R., Patel R.V., Magneto-Rheological Actuators for Haptic Devices: Design, Modeling, Control, and Validation of a Prototype Clutch, IEEE International Conference on Automation and Robotics, Seattle WA, May 26-30 2015
- **Najmaei N.**, Yadmellat P., Kermani M.R., Patel R.V., Application of Magneto Rheological Fluid Based Clutches for Improved Performance in Haptic Interfaces, IEEE International Conference on Automation and Robotics, Hong Kong, Jun 1-4 2014
- **Najmaei N.**, Kermani M.R., An Accurate and Computationally Efficient Method for Whole-Body Human Modeling with Applications in HRI, IEEE International Conference on Robotics and Automation, Shanghai, China, May 9-13 2011
- **Najmaei N.**, Lele S., Kermani M.R., Sobot R., Human Factors for Robot Safety Assessment, IEEE/ASME International Conference on Advanced Intelligent Mechatronics AIM10, Montreal QC, Canada, Jul 6-9 2010
- **Najmaei N.**, Kermani M.R., Prediction-Based Reactive Control Strategy for Human Robot Interaction, IEEE International Conference on Robotics and Automation ICRA10, Anchorage AL, USA, May 3-8 2010
- **Najmaei N.**, Kermani M.R., Evaluation Method, IEEE International Conference on Technologies for Practical Robot Applications TePRA09, Woburn MA, USA, Nov 9-10 2009
- **Najmaei N.**, Kermani M.R., Optimal Safe Planning Using a Danger Evaluation Method, 14th IASTED International Conference on Robotics and Applications RA09, Cambridge MA, USA November 24 2009
- Shames I., **Najmaei N.**, Zamani M., Safavi A.A., Application of Reinforcement Learning in Development of a New Adaptive Intelligent Traffic Shaper, IEEE International Conference on Machine Learning and Applications ICMLA06, Pittsburgh PA, USA, Jun 25-29 2006
- Shames I., **Najmaei N.**, Zamani M., Safavi A.A., A New Intelligent Traffic Shaper for High Speed Networks, IEEE International Conference on Tools with Artificial Intelligence ICTAI06, Washington DC, USA, Nov 13-15 2006

Selected Talks

- "Magneto-Rheological Fluids in Medical Robotics", Sick Kids Hospital, University of Toronto, Apr 2015.
- "Design of a Haptic Interface for Medical Applications using Magneto-Rheological Fluid Based Actuators", Faculty of Engineering, University of Porto, Jan 2015.
- "Design of a Haptic Interface for Medical Applications using Magneto-Rheological Fluid Based Actuators", Annual Symposium of Electrical and Computer Eng., Faculty of Engineering, University of Western Ontario, Jun 2013.
- "Design of a Haptic Interface for Medical Applications using Magneto-Rheological Fluid Based Actuators", IEEE Int Conf on Automation and Robotics, Hong Kong, Jun 1-4 2014.
- "An Accurate and Computationally Efficient Method for Whole-Body Human Modeling with Applications in HRI", IEEE International Conference on Robotics and Automation, Shanghai, China, May 9-13 2011.
- "Human Factors for Robot Safety Assessment", in Proc. of IEEE/ASME International Conference on Advanced Intelligent Mechatronics AIM10, Montreal QC, Canada, Jul 6-9 2010.
- "Prediction-Based Reactive Control Strategy for Human-Robot Interaction", IEEE International Conference on Robotics and Automation ICRA10, Anchorage AL, USA, May 3-8 2010.
- "Superquadric Obstacle Modeling and a Danger Evaluation Method with Application in Human-Safe Industrial Robots", IEEE International Conference on Technologies for Practical Robot Applications TePRA09, Woburn MA, USA, Nov 9-10 2009.

Research Projects

Design and Construction of a Prototype Robotic Haptic Device Based on Novel Smart Actuators (Magneto-Rheological Fluid Based Clutches)

2010-2015

Canadian Surgical Technologies and Advanced Robotics (CSTAR)

London ON, Canada

Design, Construction, and Evaluation of a novel haptic interface based on smart actuators. A new small-scale Magneto-Rheological (MR) fluid based clutch was designed and constructed. A prototype 2-DOF haptic interface was constructed based on these clutches using a distributed antagonistic configuration. The performance of the system was experimentally evaluated in bilateral teleoperated needle insertion and tissue palpation setups.

Pre-Collision Safety Strategies for Industrial Robots to Enable Safe Interaction with Humans

2007-2009

Faculty of Engineering, University of Western Ontario

London ON, Canada

This project focused on the issue of safe human-robot interaction achievable through safe planning, and reactive control, which are commonly considered as the primary means of collision-avoidance. These approaches result in intelligent and fast planning algorithm, which enables an industrial robot to better position in respond to dangerous situations with respect to the humans working in the same workspace.

Development of a New Intelligent Adaptive Traffic Shaper for Large-Scale Computer Networks

2006-2007

Faculty of Engineering, Shiraz University

Shiraz Fars, Iran

In this project, we took advantage of reinforcement learning to develop a new traffic shaper in order to obtain a reasonable utilization of bandwidth while preventing traffic overload in other part of the network. To this end, a simulation environment was created in an object-oriented C++ environment and the developed techniques were evaluated using this environment.

Modeling and Control of Shape Memory Alloy Actuators

2007

Faculty of Engineering, University of Western Ontario

London ON, Canada

The focus in this project was on modeling and simulation of shape memory alloys wire and suitable control for improving the frequency response of these systems.

Design and Construction of a Sonar-Based Mobile Robot

2006

Faculty of Engineering, Shiraz University

Shiraz Fars, Iran

Design and construction of a small mobile robot, with ultrasound network for obstacle avoidance. The mobile robot was equipped with an FPGA controller for the decision making process.

Volunteer Experiences

Academic Volunteer Activities

- Reviewer for IEEE ICRA, IEEE IROS, IEEE Transaction on Mechatronics, Int Journal of Advanced Robotic Systems, 6th International Conference on ISSNIP2010, IEEE Int. Conf. on Adv. Intell. Mechatronics, IEEE Transaction on Instrum. and Measur., IEEE Transaction on Syst., Man, & Cybern. - B, *etc.*, 2010-present
- Chair of CAMI Seminar Series, University of Western Ontario, Dec 2012
- Student Volunteer member of Organization Committee of 3rd North American Surgical Robotics Summer School, University of Western Ontario, London ON, Aug 13-17 2012
- Session Chair, Computational Biology and Bioinformatics Session, 6th Annual Canadian Student Conference on Biomedical Computing and Engineering, May 2011
- Member of the 6th Annual Canadian Student Conference on Biomedical Computing and Engineering Organizatio Committee, acted as Publication Committee Chair and Editor in Chief, 2010-2011
- Design of Lab Manuals for Linear Control Systems Course (ECE3330), University of Western Ontario, Fall 2010
- Lab Manual Designer and Coordinator, University of Western Ontario, Spring 2009
- Undergraduate Final Project Supervisor, University of Western Ontario, Spring 2009

Community Volunteer Activities

- Western GTA Union Steward of Physical Sciences, 2011-2012.
- Member of Western GTA Union Communications Committee, 2011-2012.
- Member of Western GTA Union Bylaws and Constitution committee, 2010-2011.
- Member of Western GTA Union Human Rights Committee, 2009 - 2011.
- Member of Western GTA Union Scholarship Committee, 2009-2010.
- Representative of Electrical Engineering Students of Shiraz University, 2002-2004

Professional Memberships

- IEEE Control Systems Society, 2010 – Present
- IEEE Computer Society, 2009 – Present
- IEEE Robotics and Automation Society, 2008 – Present
- IEEE Member, 2008 – Present
- Shiraz University Robotics Group, 2005 - 2006

Professional Certificates/Training

- NSERC CREATE Computer Aided Medical Interventions Program Training, 2009-2014
- Foundations of Project Management I/II, Mitacs (as part of NSERC CAMI Program Training), 2013
- Skills of Business Etiquette, Mitacs (as part of NSERC CAMI Program Training), 2013
- Proactive and Practical Communications and Teamwork, Mitacs (as part of NSERC CAMI Program Training), 2012
- Excellence of Team Building, Mitacs (as part of NSERC CAMI Program Training), 2012
- General Laboratory Safety and Hazardous Waste Management, Western University, 2010
- Workplace Hazardous Materials Information System (WHMIS), Western University, 2010

Selected Courses: Robot Control, Robot Manipulators, Telerobotics, Surgical Robotics, Non-Linear Control, Advanced Digital Control, Linear Control, Advanced Control Theory, Automation and Industrial Control, Instrumentation, Electrical Machines, Actuators Principles, Optimization Techniques, C++ Programming, Python Programming, Signal Processing, Medical Imaging Principles, Image-Guided Medical Interventions, Image Processing and Analysis, Research Ethics, *etc.*

References (contact information will be available upon request)

- Dr. Alex Mihailidis, Associate Professor, Toronto Rehabilitation Inst, University of Toronto
- Dr. Rajni V. Patel, Professor, CSTAR, London Health Science Center
- Dr. Mehrdad R. Kermani, Associate Professor, Faculty of Engineering, Western University
- More references will be available upon request