

Amir Yazdani

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SUMMARY

I am a robotics researcher with the goal of improving human-robot interaction through robot perception, planning and control. My current research includes probabilistic perception and planning in human-robot interaction and covers posture estimation, ergonomics & safety optimization, and motion & manipulation planning. I am also looking for new adventures in driver & pedestrian's state estimation and human-aware planning for self-driving vehicles.

EDUCATION

University of Utah, Salt Lake City, UT

JAN 2016 - Present

PhD in Mechanical Engineering (Robotics Track), Thesis: "*Haptic Posture Estimation and Guidance to Improve Ergonomics in Telemanipulation*", GPA: 3.8/4

AmirKabir University of Technology, Tehran, Iran

FEB 2013 - JUN 2015

MSc in Mechanical Engineering, Thesis: "*Optimal Trajectory Planning and Fault-Tolerant Control of Redundant Planar Serial Manipulators*", GPA: 17.18/20

K. N. Toosi University of Technology, Tehran, Iran

SEP 2005 - SEP 2010

BSc in Mechanical Engineering, Thesis: "*Design and Development of VirSense: A Novel Haptic Device With Fixed-Base Actuators and Gravity Compensation*", GPA: 15.03/20

SKILLS

Human-Robot Interaction

Ergonomics and safety in physical HRI, Human-aware planning, Biomechanics

AI

Pose estimation & SLAM, POMDP, HMM, Bayes filters, Smoothing, Prediction

Planning

Optimal & search-based motion planning, MPC, A*, RRT, PRM, MIQP, Convex Opt.

Software

ROS (Rviz, Gazebo, MoveIt, OpenCV, OpenNI, OpenPose, Dart tracker, Rtabmap KDL, tracK, GTSAM), Tensorflow, MATLAB Simulink, Gurobi Optimization

Hardware

Robots (Baxter, KUKA Ibr4, Omron Cobra & Viper, iRobot Create 2), Haptic robots (Quanser HD², Phantom Omni, Phantom Premium, Novint Falcon, Sensors (RGB cameras, Kinect Azure & v2, Laser range finders, Motion capture)

Teamwork/Documentation

Office, \LaTeX , Slack, Microsoft Teams, Git, Trello

EXPERIENCES

Reactive Trajectory Planning for Fixed Robots

Omron Reserach Center of America, San Ramon, CA

Robotics Research Intern, Supervisors: John Drinkard

Summer 2019

- Implementing online trajectory planning for high-speed industrial robot.

Human-Robot Interaction / Robot Perception

LL4MA Lab & Ergonomics and Safety Lab, University of Utah

Research Assistant, Supervisors: Tucker Hermans, Andrew Merryweather, Jake Abbott

Jan. 2016 - present

- Developed a new ROS package for human posture estimation in physical HRI solely from the robot's trajectory without any extra sensor. I have modeled the system as a partially-observable dynamic system and use probabilistic inference and incremental smoothing techniques to estimate the posture. I've done human subject tests using a Quanser HD² robot and compared the results with motion capture and markerless posture estimation approaches.
- Developing a ROS package for online ergonomics analysis and finding the ergonomically-optimal posture correction in physical HRI using RULA risk assessment tool and graph-based MIQP optimization.
- Explored different approaches to provide guidance from the robot to the user in physical HRI to guide the user toward a more ergonomics posture and reduce the risk of musculoskeletal disorders.
- Investigating human redundancy resolution and joint coordination to improve the posture estimation in physical HRI.

- Implemented safety parameters into an optimal motion planning algorithm using MPC for serial robots to improve safety and productivity of the task in a shared autonomy.
- Developed a haptic guidance algorithm including virtual fixtures and synthetic fixtures to guide the user through a maze using a Quanser HD² haptic robot.
- Collaborated in a project to control an under-actuated wearable arm-swing rehabilitator for gait training.
- Collaborating in exploring probabilistic risk-aware decision making that leverages the predictive models and manipulation planning to minimize the risk of patient fall in hospital room by providing supporting objects during ambulation.
- Collaborated in developing a mobile manipulation planning algorithm based on MPC/convex optimization to push/pull legged objects.
- Developed an algorithm for push planning of objects with mobile robots using a mixture of A* and RRT-connect.
- Collaborated in a project developing a ROS package for visual SLAM using RGB-D and monocular cameras on an iRobot Create2 robot.
- Collaborated in designing and developing an under-actuated robotic hand for grasping legged objects with various leg diameters.

Motion Planning / Parallel Robots

TaarLab, The University of Tehran, Tehran, Iran

Research Associate, Supervisor: Mehdi Tale Masouleh, Mohammad Bagher Menhaj

Dec. 2011 - Dec. 2015

- Developed a fault-tolerant optimal collision-free motion planning algorithm based on convex optimization and MPC for robot arms and implemented on a developed 4-DOF planar & redundant serial robot.
- Collaborated in developing an optimal collision-free motion generation algorithm based on convex optimization and MPC and implementing it on various mobile, serial and parallel robots.
- Collaborated in developing PGNGN, a neural gas network algorithm for finding the singularity-free workspace of planar parallel robots.
- Designed and developed a 4-DOF Quattro-based parallel robot with optimal singularity-free workspace.
- Designed and developed a 3-DOF and a 2-DOF spherical, and a 3-DOF Cartesian parallel robot and collaborated in dynamic modeling and computed torque control.
- Designed and developed a pneumatic 6-DOF Gough-Stewart robot and collaborated in dynamic modeling.

Haptic Robots / Driving Simulators

Virtual Reality Lab, K. N. Toosi University of Technology, Tehran, Iran

Research Assistant & Lab manager, Supervisor: Ali Nahvi

July 2008 - Sep. 2011

- Designed and developed VirSense, a 6-DOF haptic device with fixed-base actuators and 95% passive gravity compensation using linear springs.
- Designed a novel 4-DOF serial-parallel robot for real-size urban bus driving simulators and collaborated in development and kinematic analysis of the mechanism.

SELECTED COURSES

Artificial Intelligence Machine Learning Motion Planning 3D Computer Vision
Neural Networks Haptics and Physical HRI Intro to Robot Control Advanced Mechatronics

RELATED PEER-REVIEWED PUBLICATIONS

1. R. SabbaghNovin, **A. Yazdani**, A. Merryweather, T. Hermans, "A Model Predictive Approach for Online Mobile Manipulation of Nonholonomic Objects using Learned Dynamics", Submitted to *International Journal of Robotics Research (IJRR)*, also available on *arXiv*.
2. **A. Yazdani**, R. SabbaghNovin, A. Merryweather, T. Hermans, "Estimating human teleoperator posture using only a haptic-input device", Submitting to *Robotics: Science and Systems (RSS) 2020 & Robotics and Automation Letter (RAL)*.
3. R. SabbaghNovin, **A. Yazdani**, T. Hermans, and A. Merryweather, "Dynamics model learning and manipulation planning for objects in hospitals using a patient assistant mobile (PAM) robot." *IROS 2018*, Madrid, Spain.

4. R. SabbaghNovin, M. Tale Masouleh, and **M.Yazdani**. "Optimal motion planning of redundant planar serial robots using a synergy-based approach of convex optimization, disjunctive programming and receding horizon." *Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering* 230, no. 3 (2016): 211-221.
5. R. SabbaghNovin, M. Tale Masouleh, **M.Yazdani** and B. Danaei. "Optimal motion planning of a 3-DOF decoupled parallel robot using convex optimization and receding horizon concept." *Modares Mechanical Engineering* Vol.15, No. 8, (2015).
6. R. SabbaghNovin, A. Karimi, **M.Yazdani**, and M. Tale Masouleh. "Optimal motion planning for parallel robots via convex optimization and receding horizon." *Advanced Robotics*, 30, no. 17-18 (2016): 1145-1163.
7. **M.Yazdani**, R. SabbaghNovin, M. Tale Masouleh, M. Menhaj, and H. Abdi. "An experimental study on the failure tolerant control of a redundant planar serial manipulator via pseudo-inverse approach." *ICRoM 2015*, Tehran, Iran.
8. A. Mashayekhi, A. Nahvi, **M.Yazdani**, M. Mohammadi Moghadam, M. Arbabtafti, and M. Norouzi. "VirSense: a novel haptic device with fixed-base motors and a gravity compensation system." *Industrial Robot: An International Journal* 41, no. 1 (2014): 37-49.
9. R. SabbaghNovin, M. Tale Masouleh, and **M.Yazdani**. "A new neural gas network approach for obtaining the singularity-free workspace of 3-DOF planar parallel manipulators.", *Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science* (2016).

PRESENTATION & ABSTRACTS

1. **A.Yazdani**, R. SabbaghNovin, A. Merryweather, and T. Hermans. "Human posture estimation and ergonomics analysis solely from the robot in physical human-robot interaction." *17th Annual Regional National Occupational Research Agenda (NORA) Young/New Investigators Symposium*. April 2019, Salt Lake City, UT.
2. **A.Yazdani**, and A. Merryweather. "Changing perceptions of robotics in industry: recent accomplishment in safety and injury risk reduction." *National Occupational Research Symposium (NOIRS)*, October 2018, Morgantown, WV.
3. **A.Yazdani**, R. SabbaghNovin, and A. Merryweather. "Improvement of human safety in fault-tolerant human and robot collaboration using convex optimization and receding horizon control." *Expanding Research Partnership: State of The Science Conference*, June 2017, Aurora, CO.
4. A. Merryweather, R. SabbaghNovin, **A.Yazdani**, "Optimal motion and mobility aid manipulation planning to enable personal activity monitoring and facilitate safer sit-to-walk transitions", *5th International Conference on Ambulatory Monitoring of Physical Activity and Movement (ICAMPAM)*, June 2017, Bethesda, MD.

PATENTS

- 4-degree of freedom industrial-researching parallel robot with free singularity workspace, No.91977 issued by Iranian Organization of Patents Registration. 2016
- Pneumatically Actuated 6-DoF Gough-Stewart Parallel Robot, No.446327 issued by Iranian Organization of Patents Registration. 2015
- Design and Development of a Haptic Robot with Fixed-Based Actuators and Automatic Gravity Compensation, No.75817 issued by Iranian Organization of Patents Registration. 2013
- Mechanism for Rapid Video Recording, No.78963 issued by Iranian Organization of Patents Registration. 2013

AWARDS & HONORS

- Dr. Paul Richard's Safe Workplace Scholarship by WCF Insurance 2017, 2018 & 2019
- American Society of Safety Engineering Foundation Scholarship 2018, 2019
- Graduate Student Travel Assistance award, Graduate School, The University of Utah 2018
- Pilot Project Research Training (PPRT) Award from National Institute of Occupational Safety and Health (NIOSH), Award number: T420H008414-10 2016
- 1st place in Senior Demo league in Robocup IranOpen 2014