Sanjeev Sharma

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Research Interests

- Theory: Convex and Decentralized Optimization; Reinforcement Learning (RL); Multi-Agent Systems
- Applications: Autonomous Navigation; Robotics; Motion and Path Planning; Intelligent Systems and Agents

Education

- **University of Alberta (In Progress)** — Edmonton, Canada
  M. Sc., Computing Science (GPA: 3.9/4) — *Sep. 2012- Present*
  - Tentative thesis title: Effects of Time-cycle in Reinforcement Learning Robotics
  - Courses: Machine Learning (A+), Online Learning (A-), Robotics: Visual Navigation (A-), Probabilistic Graphical Models (A+), Reinforcement Learning for Artificial Intelligence and Algorithms
- **Indian Institute of Technology, Roorkee** — Roorkee, India
  Bachelor of Technology (B. Tech), Electrical Engineering (GPA: 6.275/10) — *July 2007 -May 2011*
  - B. Tech Project: Network Intrusion Detection using Reinforcement Learning (A); Group of two students

Publications

Journal Article

- Zvi Shiller, Sanjeev Sharma, Ishai Stern and Asher Stern, *On-Line Obstacle Avoidance at High Speeds.* International Journal of Robotics Research (**IJRR**), 32 (9–10), 1030–1047, 2013.

Conference Papers

- Sanjeev Sharma, *Autonomous Waypoint Generation with Safety Guarantees: On-Line Motion Planning in Unknown Environments.* International Conference on Advanced Robotics (**ICAR**), 2013.
- Zvi Shiller and Sanjeev Sharma, *On-Line Obstacle Avoidance at High Speeds.* Israeli Conference on Robotics (**ICR**), 2013 (Short Paper).
- Zvi Shiller and Sanjeev Sharma, *High Speed On-Line Motion Planning in Cluttered Environments.* IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**), 2012.
- Zvi Shiller and Sanjeev Sharma, *On-Line Obstacle Avoidance at High Speeds.* CISM-IFToMM Symposium on Robot Design, Dynamics, and Controls (**RoManSy**), 2012.
- Sanjeev Sharma, *QCQP-Tunneling: Ellipsoidal Constrained Agent Navigation.* Second **IASTED** International Conference on Robotics, 2011.

Workshop Papers

- Ujjwal Dasgupta, Sriram Srinivasan, Sanjeev Sharma and Russell Greiner, *Learning Markov Networks with Bounded Inference Complexity.* **ICML** Workshop on Interactions between Inference & Learning, 2013.
- Sanjeev Sharma and Matthew E. Taylor, *Autonomous Waypoint Generation Strategy for On-Line Navigation in Unknown Environments.* **IROS** Workshop on Robot Motion Planning: On-line, Reactive and in Real-time, 2012.

Under Review

- Sanjeev Sharma and Matthew E. Taylor, *On-Line Motion Planning in Unknown Environments Using Waypoints.* **Submitted** - International Conference on Robotics and Automation (**ICRA**), 2014.

Research Experience

- **Effects of Time-cycle in Reinforcement Learning Robotics** — M. Sc. Thesis
  Reinforcement Learning and Artificial Intelligence Lab, Prof. Richard S. Sutton — *June 2013 - present*
  - This research studies the effects of time-cycle (ΔT; the duration of an action) in the performance of reinforcement learning robotic systems. It aims to answer three important questions: (i) how to select ΔT?; (ii) does arbitrarily picking ΔT favor one approach over the other?; and (iii) can we design algorithms that work well with a wide range of ΔT? This research takes an experimental approach, using a real-time robotic system (iRobot-Create), to answer these questions.
  - Research Assistant to Richard S. Sutton; Summer 2013.

- **Autonomous Waypoint Generation for Navigation in Unknown Environments**
  Self-Initiated; and Prof. Matthew E. Taylor, Washington State University *Mar 2011 - present*
  - A framework that autonomously, and sequentially, generates waypoints (sub-goals) in the robot's field of view for navigation in unknown environments. It uses RL and convex optimization to generate waypoints and ensure safety. It was recently, successfully, tested using Clearpath's Husky A200 robot (Submitted).
  - *Publications*: **IROS Workshop** 2012; **ICAR** 2013; **ICRA** 2014 (*Submitted*)
- **Research Intern, Ariel University** Ariel, Israel
  Paslin Laboratory for Robotics and Autonomous Vehicles, Prof. Zvi Shiller *Sep 2011 - April 2012*
  - Developed an on-line motion planner, that takes the robots' dynamics and actuator constraints into account, for high speed on-line motion planning in cluttered environments.
  - *Publications*: **RoManSy** 2012; **IROS** 2012; **IJRR** 2013; **ICR** 2013
- **Research Intern, UMass Amherst** Amherst, USA
  Autonomous Learning Lab, Prof. Sridhar Mahadevan *May - Aug, 2010*
  - Combined the Sigma Points Policy Iteration (SPPI) and Proto-Value Functions, and created the Sigma Points Representation Policy Iteration algorithm. The finding of this research was that SPPI converges faster than the Least-Squares Policy Iteration (LSPI), but the fixed-point it converges to results in policy that performs poorly as compared to the policy resulting from the fixed-point to which LSPI converges.
- **Convex Optimization for Path Planning in Unknown Environments**
  Self-Initiated *Jan 2010 - July 2011*
  - Using convex formulations for on-line motion planning, in unknown environments, for robots with non-convex footprints. The robots' safety is guaranteed using the hard-constraints formulation. This problem has been, otherwise, addressed using the integer optimization (with convex relaxation) or graph search in the literature — computationally expensive and restricted to known environments.
  - *Publications*: **IASTED Robotics** 2011; **ICAR** 2013

Searching-Eye, Co-Founded: `www.searching-eye.com` (June 2009)

- Searching-Eye is a web-portal for delivering tutorials and video lectures. Through searching-eye I had delivered, while an undergraduate, 37 lectures in machine learning, convex optimization and RL.

Teaching Experience

- **Teaching Assistant: Machine Learning** CMPUT 466/551
  CS Department, University of Alberta, Graduate and Undergraduate Combined *Fall 2013*
- **Teaching Assistant: Introduction to Foundations of Computing-II** CMPUT 175
  CS Department, University of Alberta *Winter 2013*
- **Teaching Assistant: Introduction to Computing** CMPUT 101
  CS Department, University of Alberta *Fall 2012*
- **Delivered 35+ Lectures through Searching-Eye**
  Available @ Searching-Eye (searching-eye.com) *July 2009 - Jan 2011*
  - Machine Learning and Convex Analysis (July 2009 - Dec 2010); Convex Optimization (Oct 2010 - Jan 2011); Reinforcement Learning (Oct 2009 - Jan 2011)

Technical Skills

- Machine Learning, Reinforcement Learning, Convex Optimization, Subgradient Methods, Cutting-Plane Methods, Ellipsoid Methods, Decomposition Methods (Primal and Dual)
- Programming: C/C++, MATLAB, Python, Robot Operating System (ROS)
- Robots: iRobot-Create, Clearpath Husky A200, Parrot AR Drone 2.0
- Solvers/Libraries/Software: OpenGL, CVX, matplotlib, NumPy, SciPy, LaTeX
- Optimization Solvers Created: SSMS - Subgradient Solver, Available @ searching-eye.com (Dec 2010)

Achievements

- IIT-JEE: All India Rank - 1403 $\approx$ 99.5%ile (2007); Earned B. Tech in 2011
- NTSE: National Talent Search Examination - Qualified up to state level (2005)
- Best Project Award for the Lip Detection in Human Face Images project (2009)
  Sanjeev Sharma, *Human Lip Detection Including Face Segmentation Under Normal and Ill-Illuminated Conditions*. Technical Report, IIT Roorkee, 2009.

Other Activities: Reviewing

- Reviewer for: IROS 2013, ICRA 2014, Journal of Intelligent and Robotic Systems (2013)