Robotics Challenges for Machine Learning

Friday, December 7, 2007

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http://www.robot-learning.de

Robotics challenges can inspire and motivate new Machine Learning research as well as being an interesting field of application of standard ML techniques. Despite the wide range of machine learning problems encountered in robotics, the main bottleneck towards autonomous robots has been a lack of interaction between the core robotics and the machine learning communities. To date, many roboticists still discard machine learning approaches as generally inapplicable or inferior to classical, hand-crafted solutions. Similarly, machine learning researchers do not yet acknowledge that robotics can play the same role for machine learning which for instance physics had for mathematics: as a major application as well as a driving force for new ideas, algorithms and approaches.

With the current rise of real, physical humanoid robots in robotics research labs around the globe, the need for machine learning in robotics has grown significantly. Only if machine learning can succeed at making robots fully adaptive, it is likely that we will be able to take real robots out of the research labs into real, human inhabited environments. Among the important problems hidden in these steps are problems which can be understood from the robotics and the machine learning point of view including perceptuo-action coupling, imitation learning, movement decomposition, probabilistic planning problems, motor primitive learning, reinforcement learning, model learning and motor control.

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Organizers: Jan Peters & Marc Toussaint

Morning session: 7:30am–10:30am

7:30am **Welcome**,
Jan Peters, Max Planck Institute, Marc Toussaint, Technical University of Berlin

7:35am **Learning Nonparametric Policies by Imitation**,
David Grimes and Rajesh Rao, University of Washington

8:05am **Machine learning for developmental robotics**,
Manuel Lopes, Luis Montesano, Francisco Melo, Instituto Superior Técnico

8:15am **Machine Learning Application to Robotics and Human-Robot Interaction**,
Aude Billard, EPFL

8:45am *coffee break*

9:00am **Poster Spotlights**

9:20am **Bayesian Reinforcement Learning in Continuous POMDPs with Application to Robot Navigation**, *Joelle Pineau, McGill University*

9:50am **Self-Supervised Learning from High-Dimensional Data for Autonomous Offroad Driving,** *Ayse Naz Erkan, Raia Hadsell, Pierre Sermanet, Koray Kavukcuoglu, Marc-Aurelio Ranzato, Urs Muller, Yann LeCun, NYU*

10:00am **Task-based motion primitives for the control and analysis of anthropomorphic systems**, *Luis Sentis, Stanford University*

Afternoon session: 3:30pm–6:30pm

3:30am **Invited Talk: STAIR: The STanford Artificial Intelligence Robot project**,
Andrew Ng, Stanford University

4:00am **Robot Perception Challenges for Machine Learning**,
Chieh-Chih Wang, National Taiwan University

4:10am **Probabilistic inference methods for nonlinear, non-Gaussian, hybrid control**,
Nando de Freitas, University of British Columbia

4:40pm *coffee break*

5:00am **A new mathematical framework for optimal choice of actions**,
Emo Todorov, UCSD

5:30pm **Poster Spotlights**

5:50pm **Poster Session**

Posters

(1) *A Step Towards Autonomy in Robotics via Reservoir Computing/Plan Recognition and Execution with Reservoir Computing.* E. Antonelo, X. Dutoit, B. Schrauwen, D. Stroobandt, H. Van Brussel, M. Nuttin/X. Dutoit, H. Van Brussel, M. Nuttin.

(2) *Reinforcement Learning with Multiple Demonstrations.* Adam Coates, Pieter Abbeel, Andrew Y. Ng.

(3) *CRF-Based Semantic and Metric Maps/Learning to Associate with CRF-Matching.* Bertrand Douillard, Dieter Fox, Fabio Ramos/Fabio Ramos, Dieter Fox.

(4) *Self-Supervised Learning from High-Dimensional Data for Autonomous Offroad Driving.* Ayse Naz Erkan, Raia Hadsell, Pierre Sermanet, Koray Kavukcuoglu1, Marc-Aurelio Ranzato, Urs Muller, Yann LeCun.

(5) *(Machine) Learning Robot Control Policies.* Daniel H Grollman, Odest Chadwicke Jenkins.

(6) *TORO: Tracking and Observing Robot.* Deepak Ramachandran and Rakesh Gupta.

(7) *Efficient Sample Reuse by Covariate Shift Adaptation in Value Function Approximation.* Hirotaka Hachiya, Takayuki Akiyama, Masashi Sugiyama.

(8) *Improving Gradient Estimation by Incorporating Sensor Data.* Gregory Lawrence.

(9) *Relocatable Action Models for Autonomous Navigation.* Bethany R. Leffler, Michael L. Littman.

(10) *Machine learning for developmental robotics.* Manuel Lopes, Luis Montesano, Francisco Melo.

(11) *Policy gradient approach to multi-robot learning.* Francisco Melo .

(12) *Learned system dynamics for adaptive optimal feedback control.* Djordje Mitrovic, Stefan Klanke, and Sethu Vijayakumar.

(13) *Learning Robot Low Level Control Primitives: A Case Study.* Diego Pardo, Cecilio Angulo, Ricardo Tellez.

(14) *Active Learning for Robot Control.* Philipp Robbel, Sethu Vijayakumar, Marc Toussaint.

(15) *Learning 3-D Object Orientation from Images.* Ashutosh Saxena, Justin Driemeyer and Andrew Y. Ng.

(16) *Towards Active Learning for Socially Assistive Robots.* Adriana Tapus, Maja Matari.

(17) *The conditioning effect of stochastic dynamics in continuous reinforcement learning.* Yuval Tassa,.

(18) *Reinforcement Learning and Weak Derivatives for Motor Learning in Robotics.* E. A. Theodorou, J. Peters, S. Schaal.

(19) *Bayesian Nonparametric Regression with Local Models.* Jo-Anne Ting, Stefan Schaal.

(20) *Tekkotsu as a Framework for Robot Learning Research.* David S. Touretzky, Ethan J. TiraThompson.

(21) *Robot Perception Challenges for Machine Learning.* Chieh-ChihWang.

(22) *Maximum Entropy Inverse Reinforcement Learning.* Brian D. Ziebart, J. Andrew Bagnell, Anind K. Dey.