

Research Topic for the ParisTech/CSC PhD Program

(one page maximum)

***Field (cf. List of fields below):** Information and Communication Sciences and Technologies

Subfield: Machine-Learning

Title: Deep Reinforcement Learning (DRL) for teaching behaviors to collaborative robots

ParisTech School: MINES ParisTech

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Short description of possible research topics for a PhD: (10-15 lines in English + optional figure)

Since 2012, the breakthrough of Deep Convolutional Networks (convNets) has brought tremendous progress in Image Understanding. Furthermore in 2017, the AlphaGO algorithm obtained by Reinforcement Learning (RL) succeeded in beating human go player world champions. This has fostered huge interest in Deep Reinforcement Learning (DRL) as an extremely promising paradigm for the design of behavior and planning of robots and autonomous vehicles.

The center for Robotics of MINES ParisTech already conducts research on DRL for end-to-end vehicle driving, and on Human actions/gestures understanding for Collaborative Robots in the factory of the future. *The proposed research topic is to focus on Deep Reinforcement Learning (DRL) for teaching behaviors to collaborative robots*. One of the current issues regarding RL is the usually very slow training, requiring huge number of trials and errors. For collaborative robots, another approach for teaching behavior is “learning by demonstration”. A promising research direction is therefore to leverage the latter within DRL, in order to drastically accelerate robot behavior learning.

Required background of the student: Machine-Learning, Deep-Learning, Robotics

A list of 5(max.) representative publications of the group: (Related to the research topic)

"Coupled Longitudinal and Lateral Control of a Vehicle Using Deep Learning", Guillaume Devineau, Philip Polack, Florent Alché and Fabien Moutarde, proc. of 21st IEEE International Conference on Intelligent Transportation Systems (ITSC'2018), Maui, Hawaii, USA, November 4-7, 2018.

["End to End Vehicle Lateral Control Using a Single Fisheye Camera"](#), Marin Toromanoff, Emilie Wirbel, Frédéric Wilhelm, Camilo Vejarano, Xavier Perrotton et Fabien Moutarde, 2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2018), Madrid (Spain), 1-5 oct. 2018.

["Multi-users online recognition of technical gestures for natural Human-Robot Collaboration in manufacturing"](#), Eva Coupeté, Fabien Moutarde and Sotiris Manitsaris, *Autonomous Robots* journal, <https://doi.org/10.1007/s10514-018-9704-y>, 2018.

["Deep Learning for Hand Gesture Recognition on Skeletal Data"](#), Guillaume Devineau, Wang Xi, Fabien Moutarde and Jie Yang, proc. 13th IEEE Conference on Automatic Face and Gesture Recognition (FG'2018), Xi'An (China), 15-19 May 2018.

["A Distributed MPC Framework for Road-Following Formation Control of Car-like Vehicles"](#), Xiangjun Qian, Florent Alche, Arnaud de La Fortelle and Fabien Moutarde, proc. of 14th International Conference on Control, Automation, Robotics and Vision (ICARCV'2016), Phuket (Thailand), November 13–15, 2016.
