

IDP: Learning Motion Primitives from Invariant Representation

Informatics:

M. Sc. Informatics is designed to provide a solid grounding in computing systems, structures, and mathematical principles. Mr. Reguant area of specialization, Artificial Intelligence and Robotics, award him the opportunity to explore this master's specific segment in greater depth. His master, research-oriented, builds on this fundamentals. The Department offers him a wide range of areas giving him a broad theoretical background base to confront this problem.

The degree introduces Mr. Reguant to the essential concepts and principles of programming languages, IT architecture, algorithms and data structures, software engineering, machine learning and artificial intelligence among others. This knowledge base acquired during his studies places him on the ideal position for our IDP. Specially the knowledge acquired in the lectures of Techniques in Artificial intelligence and his current lecture of Machine Learning will be widely used during his time in our group.

The knowledge acquired during his lectures will be applied in form of algorithms. The informatics department should have already provided Mr. Reguant with the ability to implement the desired algorithms for this IDP. In this specific case the algorithms required are going to be Gaussian Processes (GP) and Support Vector Machine (SVM). Once both are implemented they are going to be used to compare the data obtained with the state-of-the-art.

Dynamic Human-Robot Interaction research group:

This IDP gives Mr. Reguant to put in practice all the theoretical concepts acquired on the previous semesters of his master into a practical work. This practical activity not only provides him the possibility to improve and sharpen his engineering skills but also his time management skills and intercultural communication at our laboratory.

This undertaking provides him the chance to apply the learned skills from different lectures. The student will learn how to document his approach and present the results to the whole research group in a scientific approach. This IDP involves the independent, in-depth study of learning invariant representation and real time robot interaction. Mr. Reguant is required to develop a solution to a specific problem and analyze, evaluate, and document his methods and processes.

This project gives him the opportunity to develop solid theoretical, practical, and technical skills in human-robot interaction. At the end Mr. Reguant is required to present a scientific seminar presentation and provide the documentation from his work.

The experience that he will extract and could not get in any other informatics research group is diverse. First of all and most important he will learn about Invariant Space and get to know that there are other forms to represent 3D movement. Secondly but not less important the student is going to use ROS API to create an interaction between the computer and the robot so he can execute experiments.

Work schedule:

- Code the algorithm that transforms the motion trajectories obtained through ROS into the invariant representation presented in [1]
- Implement Gaussian Process (GP) that analyzes and extracts regularities from the invariant trajectories.
- Implement Support Vector Machine (SVM) that analyzes and extracts regularities from the invariant trajectories.
- Compare the implemented learning techniques (GP/SVM) for the invariant space.
- Compare with the state of the art approach in [2]

Lecture content:

“Machine Learning in Robotics” is considered to be the lecture that better suits this IDP. The lecture imparts understanding of methods from pattern classification, recognition and machine learning. In particular this lecture leads the students to the robotic applications using machine learning techniques.

After the lecture Mr. Reguant should be able to apply state-of-the-art machine learning algorithms in his interested problems. Also, he should be qualified in doing research in machine learning in robotics. Meaning that his IDP result should into a higher quality otherwise not foreseeable.

Bibliography:

1. R. Soloperto, M. Saveriano and D. Lee. **A Bidirectional Invariant Representation of Motion for Gesture Recognition and Reproduction.** in *International Conference on Robotic and Automation*, 2015.
2. S. Calinon, Z. Li, T. Alizadeh, N.G. Tsagarakis and D.G. and Caldwell. **Statistical dynamical systems for skills acquisition in humanoids.** in *International Conference on Humanoid Robots*, 2012.

Supervisor: M. Sc. Matteo Saveriano

Start: 01.12.2015

Delivery: 30.09.2016

(D. Lee)
Carl-von-Linde Fellow