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Bringing Geometric Methods to Robot Learning, Optimization and Control

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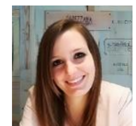

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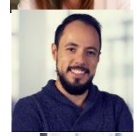

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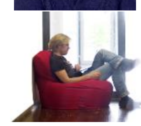

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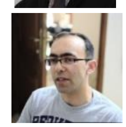

Outline and Objectives

In many robotic applications, robots are required to react to new situations, act in unstructured and dynamic environments, and overcome uncertainty. This entails to have outstanding adaptation capabilities so that robot actions lead to successful performance. A key component in both data-driven learning and adaptation is how robots may exploit explicit (e.g. domain knowledge) or implicit (e.g. learned) structures arising in the collected data. Domain knowledge and data structures in robotics can be viewed from a geometric perspective as different variables and problems have specific geometric characteristics. Rigid body orientations, controller gains, inertia matrices, manipulability ellipsoids or end-effector poses are examples of variables with predefined geometric structure. These diverse types of variables do not belong to a vector space and thus the use of classical Euclidean space methods for treating and analyzing these variables is inadequate. In this context, differential geometry, or more specifically Lie group and Riemannian manifold theories provide appropriate tools and methods to cope with or to learn the geometry of non-Euclidean parameter spaces.

The main objective of this workshop is to attract the interest of the robotic community on geometric methods, which have been overlooked in robot learning, control and optimization. Moreover, we expect this workshop will raise awareness on the importance of geometry in the different research branches of robotics. We aim at bringing together researchers from various robotic fields to discuss the benefits and explore the challenges of bringing geometry-awareness to solve robotic problems. Finally, we aim at building bridges between the robotic community and mathematicians, as well as machine learning researchers, in order to efficiently tackle the upcoming challenges involving differential geometry and robotics.