Modeling, Control, and Trajectory Optimization by Exploiting Lie Group Symmetry

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Abstract

The kinodynamic motion planning or trajectory optimization is fundamental in robotics. The nonconvexity caused by rigid body systems makes it hard for gradient-based methods to find the globally optimal solution. However, the nonconvexity can be coordinate-dependent and resolved via convex relaxation. I will discuss how we formulate the discrete-time planning problem of the rigid body as a Polynomial Optimization Problem (POP) via Lie group variational integrator. We leverage Lasserre's hierarchy of moment relaxation to obtain the globally optimal solution via Semidefinite Programming (SDP). In addition, I will present recent results on modeling and control of rigid body systems by exploiting symmetry. The goal is to illustrate a picture of current progress for rigid body systems and to motivate the proposed work in this project by contrasting the shortcomings.

In the end, I will conclude with a discussion of how these ideas provide the foundations of the proposed work for modeling and learning for high-dimensional open hybrid dynamical systems.

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