

AN OPTIMIZATION PROBLEM ON THE LIE GROUP $SO(2,1)$

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Abstract

In this study, the motion planning problem for the rigid body systems is formulated as an optimal control problem on the Lie group $SO(2,1)$ for timelike, lightlike and spacelike cases, where the cost function to be minimized is the integral of the curvature squared. The coordinate free Maximum Principle is then applied to solve this problem. The emphasis of this study is placed on an integrable case where the necessary conditions for optimality can be analytically. In addition the corresponding optimal motions are expressed in a coordinate free manner, that is they are described completely in terms of the geometrically invariant natural curvatures. These optimal motions are shown to trace helical paths which could be useful in motion interpolation schemes. This problem formulation is both practical for the path planning application considered and illuminates how the general theory of optimal control, framed curves and left-invariant Hamiltonian systems applies to this particular setting.