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OPTIMAL MOTION PLANNING FOR MOBILE OBSERVERS BASED ON MAXIMUM VISIBILITY

P. K. C. Wang

Department of Electrical Engineering
University of California, Los Angeles, California 90095

Abstract. Various problems associated with optimal motion planning for mobile observers such as mobile robots equipped with cameras or optical sensors to obtain maximum visual coverage of a surface in the three-dimensional Euclidean space are considered. These problems are posed as optimal control problems involving set measures. The existence of solutions to these problems is discussed first. Then, optimality conditions in the form of variational inequality and maximum principle are presented. Numerical algorithms for solving the corresponding approximate problems are proposed. Detailed solutions to the optimal motion planning problems for a simple example are given.
Key Words. Optimal motion planning, optimal control, visibility, mobile observers.
AMS (MOS) subject classification: 49J15, 49K15, 49J52, 93C15, 68T40.

1 Introduction

In the surveillance or planetary exploration of a given spatial domain using mobile robots equipped with cameras or optical sensors, it is desirable to select a path along which complete or maximum visual coverage of a given terrain is attained over the shortest or a specified observation time interval respectively. Similar problem arises in the health-monitoring and control of micro-distributed systems [10] such as micro-opto-electromechanical systems composed of micromachined solid structures, a possible option is to use a single mobile optical sensor to observe the structural surface. Most of the published works on motion or path planning for mobile robots [2]-[5] are based on obstacle collision avoidance. Here, we consider optimal motion planning problems based on visibility. Recently, the problem of determining the minimum number and locations of stationary line-of-sight point observers or sensors attached to a given platform for complete coverage of a surface in the three-dimensional Euclidean space R^3 has been studied [11]-[12]. Subsequently, various static optimal path planning problems based on maximum visibility have also been investigated [13]. The results of the latter work serve as a basis for the present study. As in [13], the observation points (referred to hereafter as *mobile observers*) are restricted to a path which is to be determined according to a given criterion. In some respects, the static path planning problems for complete visibility are akin to the "Art Gallery