

Strategy Synthesis for Surveillance-Evasion Games with Learning-Enabled Visibility Optimization

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Abstract—This paper studies a two-player game with a quantitative surveillance requirement on an adversarial target moving in a discrete state space and a secondary objective to maximize short-term visibility of the environment. We impose the surveillance requirement as a temporal logic constraint. We then use a greedy approach to determine vantage points that optimize a notion of information gain, namely, the number of newly-seen states. By using a convolutional neural network trained on a class of environments, we can efficiently approximate the information gain at each potential vantage point. Subsequent vantage points are chosen such that moving to that location will not jeopardize the surveillance requirement, regardless of any future action chosen by the target. Our method combines guarantees of correctness from formal methods with the scalability of machine learning to provide an efficient approach for surveillance-constrained visibility optimization.

I. INTRODUCTION

Over the last decade, the use of autonomous agents, such as unmanned aerial vehicles, for patrolling and surveillance

of such games studied in [17], [18], including the case in which the environment is not known apriori [19], [20]. These settings, however, only handle a simple surveillance requirement, namely to never lose sight of the target. For example, in [21] the authors formulate the problem as a two-player game in which both players choose their controls at initial time and proceed until the target is able to hide. If this requirement is relaxed, the agent may not always observe, or even know, the exact location of the target. In this case, surveillance is, by its very nature, captured by a partial-information two-player game.

While there has been a lot of work on both surveillance and patrolling individually, there has been very little on the combination of the two problems. To bridge this gap, this paper proposes a method for maximizing the visibility of the environment for the patrol objective while *actively maintaining knowledge* of the location of a hostile target