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Abstract

Model-based view planning is to find a near-optimal set of viewpoints that cover the surface of a target geometric model. It has been applied to many building inspection and surveillance applications with Unmanned Aerial Vehicle (UAV). Previous approaches proposed in the past few decades suffer from several limitations: many of them work exclusively for 2D problems, generate only a sub-optimal set of views for target surfaces in 3D environment, and/or generate a set of views that cover only part of the target surfaces in 3D environment. This paper presents a novel two-step computational method for finding near-optimal views to cover the surface of a target set of buildings using voxel dilation, Medial Objects (MO), and Random-Key Genetic Algorithm (RKGA). In the first step, the proposed method inflates the building surfaces by voxel dilation to define a sub-volume around the buildings. The MO of this sub-volume is then calculated, and candidate viewpoints are sampled using Gaussian sampling around the MO surface. In the second step, an optimization problem is formulated as (partial) Set Covering Problem and solved by searching through the candidate viewpoints using RKGA and greedy search. The performance of the proposed two-step computational method was measured with several computational cases, and the performance was compared with two previously proposed methods: the optimal-scan-zone method and the randomized sampling-based method. The results demonstrate that the proposed method outperforms the previous methods by finding a better solution with fewer viewpoints and higher coverage ratio compared to the previous methods.

Keywords: `View Planning`, `Medial Objects`, `UAV`, `Random-Key Genetic Algorithm`, `Voxel Dilation`

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