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Distributed trajectory optimization for multiple solar-powered UAVs target tracking in urban environment by Adaptive Grasshopper Optimisation Algorithm

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# 1 Distributed trajectory optimization for multiple solar-powered UAVs target tracking

## 2 in urban environment by Adaptive Grasshopper Optimisation Algorithm

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9 **Abstract:** Aiming at the trajectory optimization of the solar-powered UAVs (SUAVs) cooperative target tracking in urban  
10 environment, the distributed model predictive control (DMPC) method based on Adaptive Grasshopper Optimisation  
11 Algorithm (AGOA) is proposed in this paper. Firstly, the cooperative target tracking problem in urban environment is modeled  
12 by formulating the SUAVs kinematic and target models, the urban environment constraints, solar power harvesting and  
13 consumption models for SUAV, and sight occlusions by constructions. Especially, the sight occlusions in urban environment  
14 for SUAV are taken into consideration for the first time in this paper. A judgement method of sight occlusions for SUAV is  
15 proposed to make the calculation of the energy index more precise. Second, based on the precise modeling, the DMPC method  
16 is adopted as the framework for trajectory optimization in real time. Third, AGOA, a novel intelligent algorithm to mimic the  
17 behaviors of grasshoppers, is proposed to be the DMPC solver. The proposed AGOA has a better searching ability than the  
18 traditional GOA and some other intelligent algorithms by introducing some improvement measures e.g. the natural selection  
19 strategy, the democratic decision-making mechanism, and the dynamic feedback mechanism based on the 1/5 Principle. Finally,  
20 the effectiveness of the proposed method is demonstrated by the simulations.

21 **Key words:** Solar-powered UAVs (SUAVs); Target tracking; Urban environment; Sight occlusions; Distributed model  
22 predictive control (DMPC); Adaptive Grasshopper Optimisation Algorithm (AGOA)

### 23 1. Introduction

24 Solar-powered unmanned aerial vehicle (SUAV) has a better endurance performance than the traditional UAV and it has  
25 been widespread concerned in recent years. Many researchers focus on increasing the energy utilization efficiency of SUAV.  
26 An effective methodology is to optimize the flight trajectory of SUAV so that the solar cells can receive more solar radiation.  
27 Klesh, et al. [1,2] establish the energy harvesting and consumption models for SUAV and design the energy-optimal path for

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