Problem Chosen	2021 MCM/ICM Summary Sheet	Team Control Number
B		2120710

Fighting Wildfire with Unmanned Aerial Vehicle

Summary

在这里写 summary

key words : 关键词 1; 关键词 2; 关键词 3

Budget Request

FROM: Team 2120710 , MCM
To: The group of Governors
Date: February 8, 2020

这里是 br 正文。

Sincerely yours,
MCM Team 2120710

Contents

1 Introduction

1.1 Restatement of the Problem

Many people...Therefore we are facing the following problems:

- aaaaaa
- aaaaaaa

1.2 Our Works

- aaaaaaa
- aaaaaa

2 Assumptions and Notations

2.1 Assumptions

Due to the lack of necessary data, we make the following assumptions to help us perform modeling:

1. The circumstance remain unchanged in the time interval we investigated.
2. We omit the possibility of any other kinds of aerial vehcle or flying creature hitting our UAV.
3. Accroding to Bureau of Meteorology of Australian Government, litghting is the major causation of bushfire in some area, Victoria included. [1] Based on this fact, we evaluat the possibility for a certain place to catch fire with the possibility of a lightning to occour there.
4. We adopt the Equal Possibility Hypothesis when our UAVs are patrolling for the purpose of monitoring any outbreak of fire.Under this hypothesis, an area of high possibility to catch fire indicates

the frequency of fire outbreak here is high, thus the command center should pay closer attention to this area to alarm fire outbreaks timely.

5. All UAVs are equipped with a timer.
6. All UAVs are directed by a preprogrammed system given by us, which means they are all automatic.
7. Staffes are always available in any charging stations, which guarantees the UAVs will always work in the stanterd situation.
8. A drone can carry either a set of thermal imaging cameras and telemetry sensors or a radio repeater. The former combination can and can only detect any fire outbreak, while the latter can and can only extend the valid zone of radio wave signals.

2.2 Notations

2.2.1 *ijk*-coordinate system

Before illustrating the notations for model construction, we would like to introduce a special coordinate system called ***ijk*-coordinate system**[2], which was first proposed by Uber Technologies Inc. Discrete hexagon planar grid systems naturally have 3 coordinate axes spaced $120°$ apart. We refer to such a system as an *ijk* coordinate system, for the three coordinate axes i, j, and k.

2.2.2 Notations

Here are all the notations and their meanings in this paper.

3 Model Construction

blablablabla

4 Conclusion

We build a.....interesting findings:

- aaaaaaa

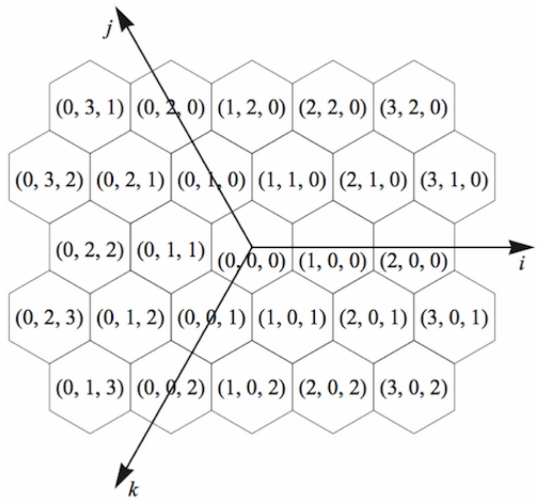

Figure 1: One possible map example that using the *ijk* coordinate system

- aaaaaaa

References

[1] M. Kilinc and J. Beringer, "The spatial and temporal distribution of lightning strikes and their relationship with vegetation type, elevation, and fire scars in the northern territory," *Journal of Climate*, vol. 20, no. 7, pp. 1161 – 1173, 01 Apr. 2007. [Online]. Available: https://journals.ametsoc.org/view/journals/clim/20/7/jcli4039.1.xml

[2] "The h3 core library documentation: Coordinate systems," https://h3geo.org/docs/core-library/coordsystems.

Appendices

Here is Code we used in our model, which python is the main development language.

Appendices A

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Table 1: Notations used in model construction

Notation	Meaning
$M(i,t)$	Position of the i-th drone I at time t
$R(j,t)$	Position of the j-th drone II at time t
$h(x,y,z)$	Elevation of the point (x,y,z)
$S(x,y,z)$	Fire history of the point (x,y,z) in the passed 5 years
$a_i(x,y,z)$	Fire history of the point (x,y,z) in the $2020-i$-th year, $i \in [1,5] \cap \mathbb{N}$
$F(x,y,z)$	Vegetative and structural condition of the point(x,y,z)
$S(i,x,y,z,t)$	Strength of the signal from the i-th drone at point (x,y,z) at time t
$E(x,y,z,N)$	Supervisory density of the point (x,y,z) when there are N drones in the field
$Slope(x,y,z)$	Maximum slope of the point (x,y,z)
$\beta(x,y,z)$	Weight of slope
γ	Factor for slope
$\omega(x,y,z)$	Decreasing rate of signal at point (x,y,z)
α	Elevational factor
$Chg(q,x,y,z)$	qth charging station's position
V_{max}	Maximum flying velocity of a drone
N_{SSA}	Total number of drone I
$N/repeater$	Total number of drone II
PF	Power consumption for a flying drone
PH	Power consumption for a hovering drone
$t_{flying}(T,l)$	Total time interval for flying at time T for l-th drone
$t_{hovering}(T,l)$	Total time interval for hovering at time T for l-th drone
T	Total time
Br	Total power for a drone
Ini	The position of command center