

For office use only

T1 _____

T2 _____

T3 _____

T4 _____

Team Control Number

1923964

Problem Chosen

B

For office use only

F1 _____

F2 _____

F3 _____

F4 _____

2019 Mathematical Contest in Modeling (MCM) Summary Sheet

(Attach a copy of this page to each copy of your solution paper.)

Go Safe with Drones

Summary

We use Dijkstra Algorithm and Particle Swarm Optimization (PSO) to develop a set of models which can solve for a universally practicable DroneGo disaster response system.

Before model construction, we make some basic assumptions essential to further analyses. To model reasonably and effectively, we define three computable optimization objectives.

First, we rebuild a three-dimensional map by interpolation with intensive data collection. Deriving an equation of flying time versus payload and the pattern of onboard cameras' scanning, we pay attention to the models' authenticity.

Next, we design an optimization model for delivery to minimize the total delivering time. Adopting Optimal Combination Algorithm (OCA), we provide a detailed and universal solving strategy to identify the best locations. Moreover, Dijkstra Algorithm is applied to derive the drones' three-dimensional delivery routes. To design the reconnaissance model, we creatively transform the evaluation problem of road segments to the evaluation of settlements. This easy-to-practice model reduces the problem's complexity remarkably. General importance, a quantifiable index, is introduced for evaluation. Then we use improved PSO algorithm to identify the best reconnaissance area.

Based on two models above, we build a combined model to address multi-objective optimization problems. Different weights of objectives are introduced according to specific scenarios. Provided the weights, we can solve for optimal results.

In addition, we apply our models to Haiti's earthquake in 2010 to test the practicability and effectiveness. The predicted locations of containers are approximately overlapped with the relief centers at that time, which demonstrates our models' universality. Furtherly, we conceive a more comprehensive model including the factors of weather conditions and the extent of damage.

Finally, we conduct sensitivity analyses and prove our models to be quite robust against the changes in the method of assigning settlement's importance.

