EPFL
ENAC TRANSP-OR
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Decision-aid Methodologies in Transportation
Spring 2015

Exercise session 12

Path planning for unmanned aerial vehicles

This exercise is based on the case study that has been presented during the class.

1 Introduction

The main challenge with respect to an unmanned aerial vehicle is the design of a route that allows it to accomplish its operations. Due to flying range limitations, it is crucial to provide a shortest route (minimum time). In addition, the proposed route should have the following properties:

a) It should be based on the kino dynamic aspect for aircraft.

b) It should respect the maximum speed of the aircraft.

c) It should be compatible with aircraft turning capabilities (minimum turn radius).

d) It should avoid dangerous and forbidden areas during the flight.

As an expert in decision making, your task is to provide a route planning tool for the aircraft in *two dimensions*.

2 Tasks

1. Write the mathematical model in non-linear form.
2. Propose an approach that approximates travel distance. We will call this model *the discrete path method*. List the advantage and disadvantage of this approach.
3. Propose another approach that approximates travel time. We will call this model *the discrete time method*.
4. Develop the mathematical model for the discrete time method.
   a) Write the objective function.
   b) Write the constraints to respect the aircraft's maximum speed and minimum turn radius.
   c) Test your model on the available data. The solution should be a straight line from an origin to a destination.
   d) Write the constraints to avoid obstacles on the route.

e) Implement your model in CPLEX. As you can see, there is a possibility that the aircraft hit the corner of an obstacle. Propose a method to fix this problem. Modify the constraints and rerun the model.

5. List the advantage and disadvantage of the discrete time approach.

6. The above approximation approaches have some merits and pitfalls. For real life problems, these approaches may not be practical. As an expert, how can you combine these approaches in order to provide a better decision tool for route planning?

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