AAE2004 Introduction to Aviation Systems
AAE
Design of Path Planning Algorithm for Aircraft Operation

Week 4: Additional Cost Area

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Flight planning considering trip cost

The fundamental rationale of the cost index concept is to achieve minimum trip cost by means of a trade-off between operating costs per hour and incremental fuel burn.

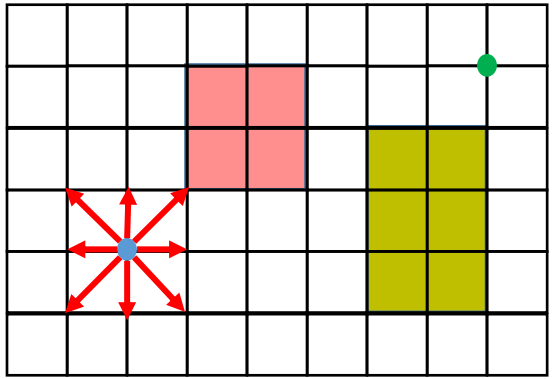
$$C = C_F \cdot \Delta F + C_T \cdot \Delta T + C_c$$

With

- C_F=cost of fuel per kg
- C_T=time related cost per minute of flight
- C_c=fixed cost independent of time
- C_T=time related cost per minute of flight
- ΔF=trip fuel (e.g. 3000kg/h)
- ΔT=trip Time (e.g. 8 hours from Hong Kong to Paris)

Can we consider this cost to our path planning to imitate the path planning for flights?

Flight planning considering trip cost



- Start node
- Goal node

Fuel-consuming area: the volume of fuel consumption is twice larger than other area duet to unstable airflow. (additional cost ΔF_a)

Time-consuming area: the flying speed is limited due to the air traffic control. (additional cost ΔT_a)

Cost can be calculated using the following formula:

$$f(x,y) = g(x,y) + h(x,y)$$

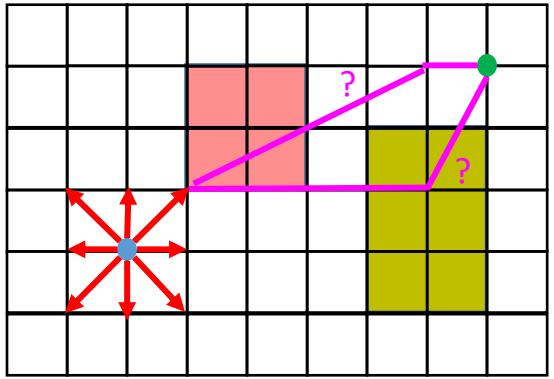
One white grid with cost as follows for $g(x,y)\&h(x,y)$:

$$\mathrm{C} = C_F \cdot \Delta F + C_T \cdot \Delta T + C_c$$

One colored grid with cost as follows for $g(x,y)\&h(x,y)$:

$$\mathrm{C} = C_F \cdot (\Delta F + \Delta F_a(x,y)) + C_T \cdot (\Delta T + \Delta T_a(x,y)) + C_c$$

How we choose the routes ?



- Start node
- Goal node

It depends on the ΔF_a and ΔT_a

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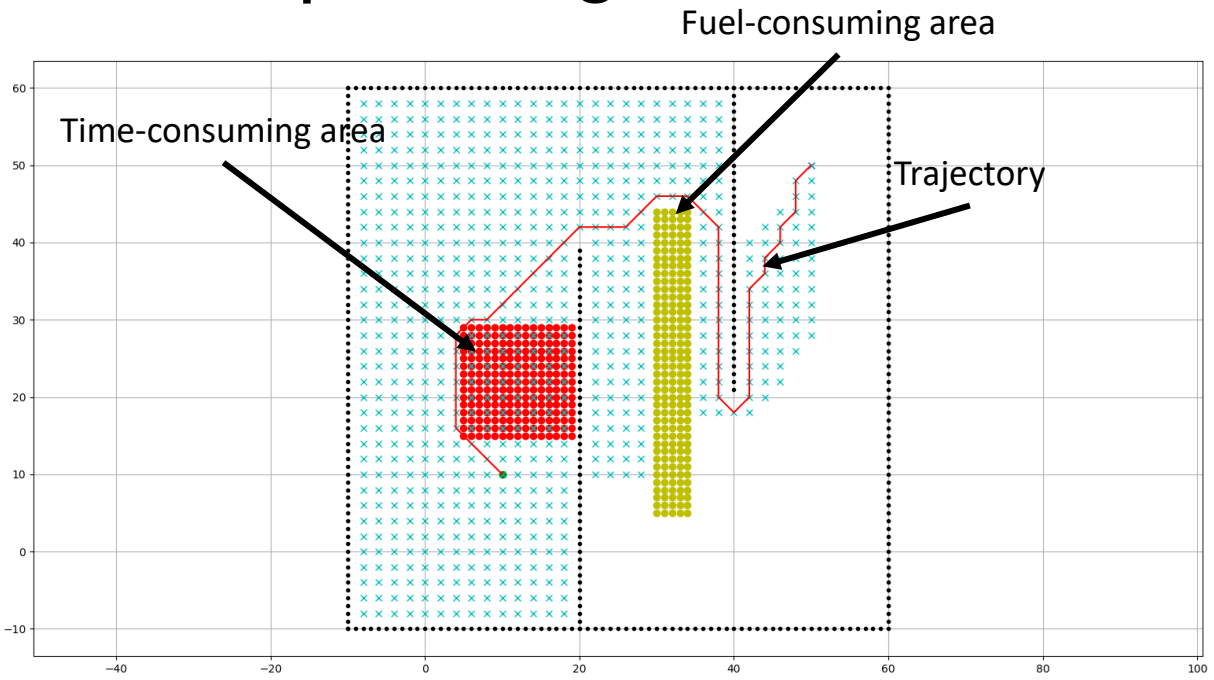
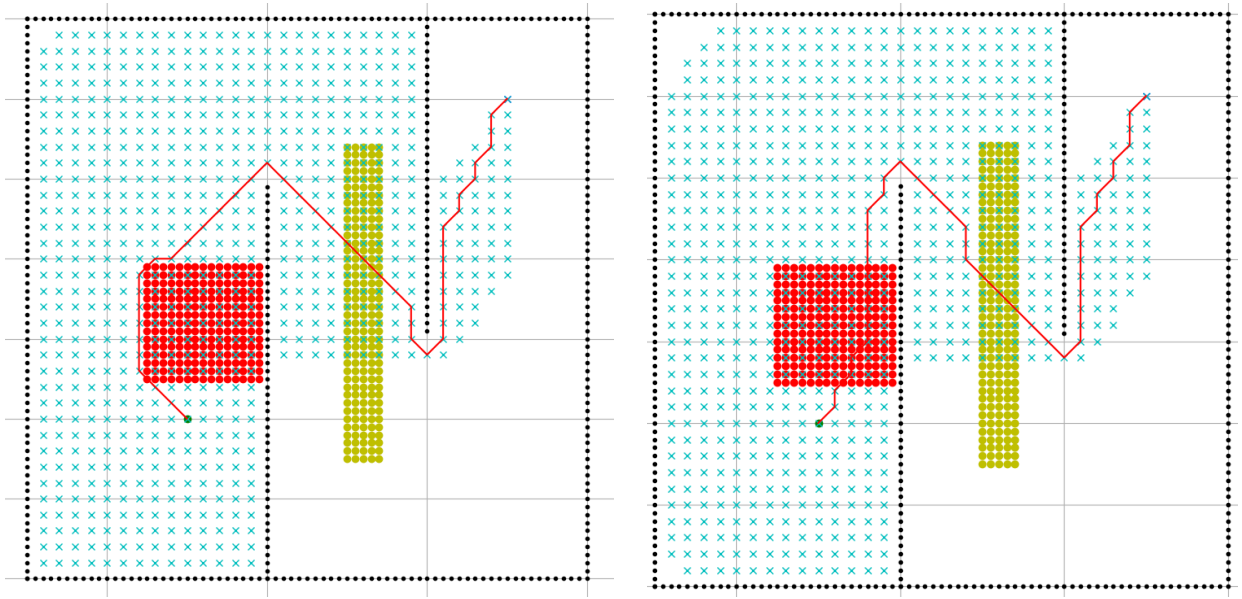
Example route planning



Avoiding the Fuel-consuming and time-consuming area if their cost is too high?

Example route planning



Go through the fuel-consuming and time-consuming area if their additional cost is quite small?

Design your route

Aircraft Model	C_F	ΔF	C_T	ΔT	C_c	ΔF_a	ΔT_a
PolyU-A380	1	1	2	5	10	0.2	0.2
PolyU-A381	1	1.5	3	5	10	0.3	0.4
PolyU-A382	1	2.0	4	5	10	0.4	0.5
PolyU-A383	1	2.5	5	5	10	0.5	0.1

$$\mathrm{C} = C_F \cdot \Delta F + C_T \cdot \Delta T + C_c$$

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