Method to Analyse Air Traffic Situation Based on Air Traffic Complexity Map

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2. Definition of Air Traffic Complexity
3. Sector-Aircraft Model
4. Air Traffic Complexity Map
5. Time Revolution of Complexity Map
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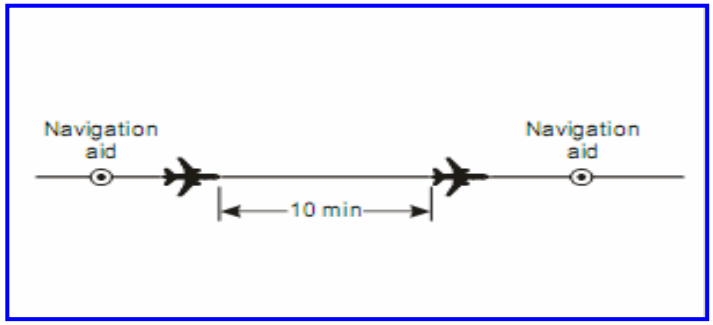
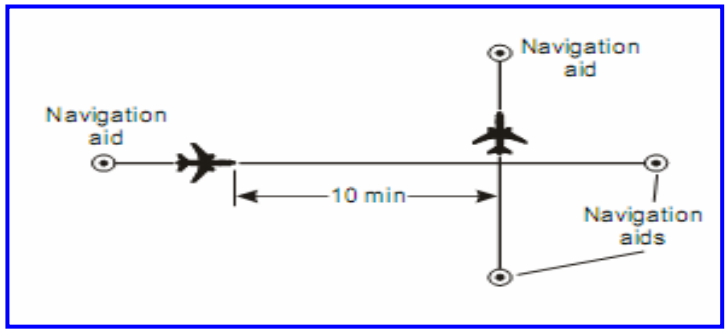
Background

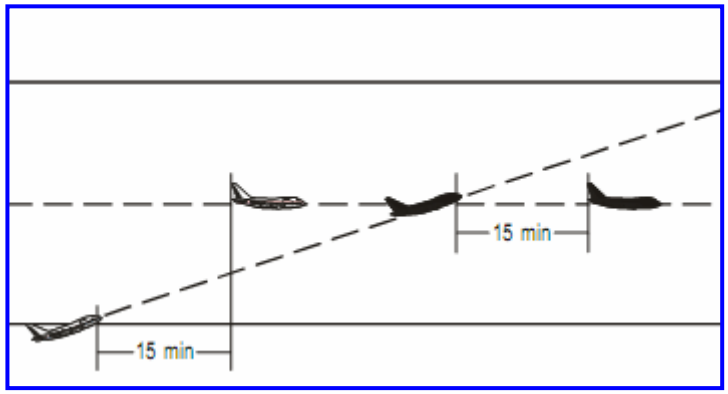


Traffic Volume = 2



Traffic Volume = 2 ?

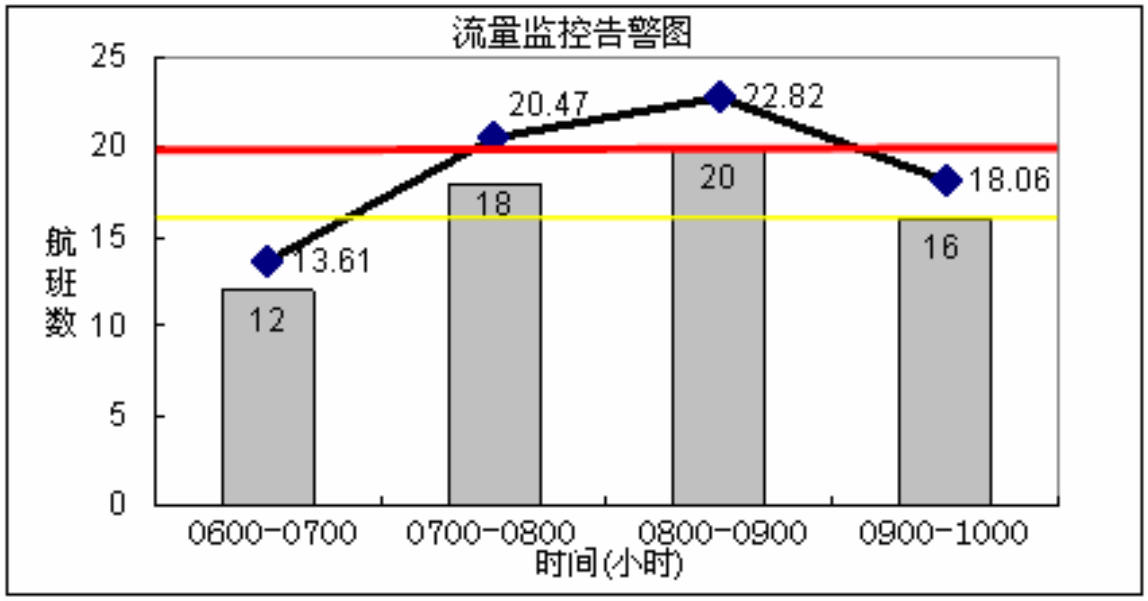
HOW TO ALERT?



Traffic Volume = 2? ?

Background

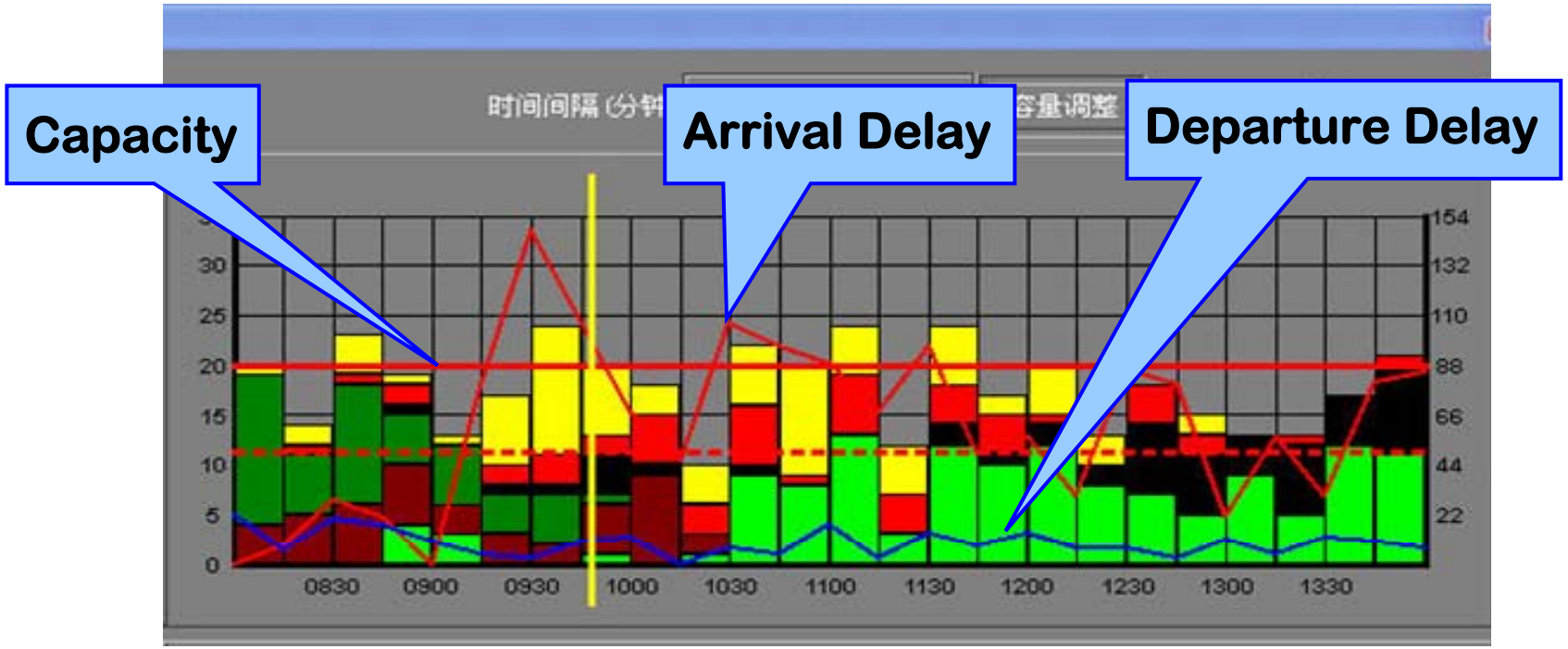
Workload have been used to redefine traffic volume



—— Zhao Yifei, A New Flow Alert Index for Sector Congestion and Its Application, 2009

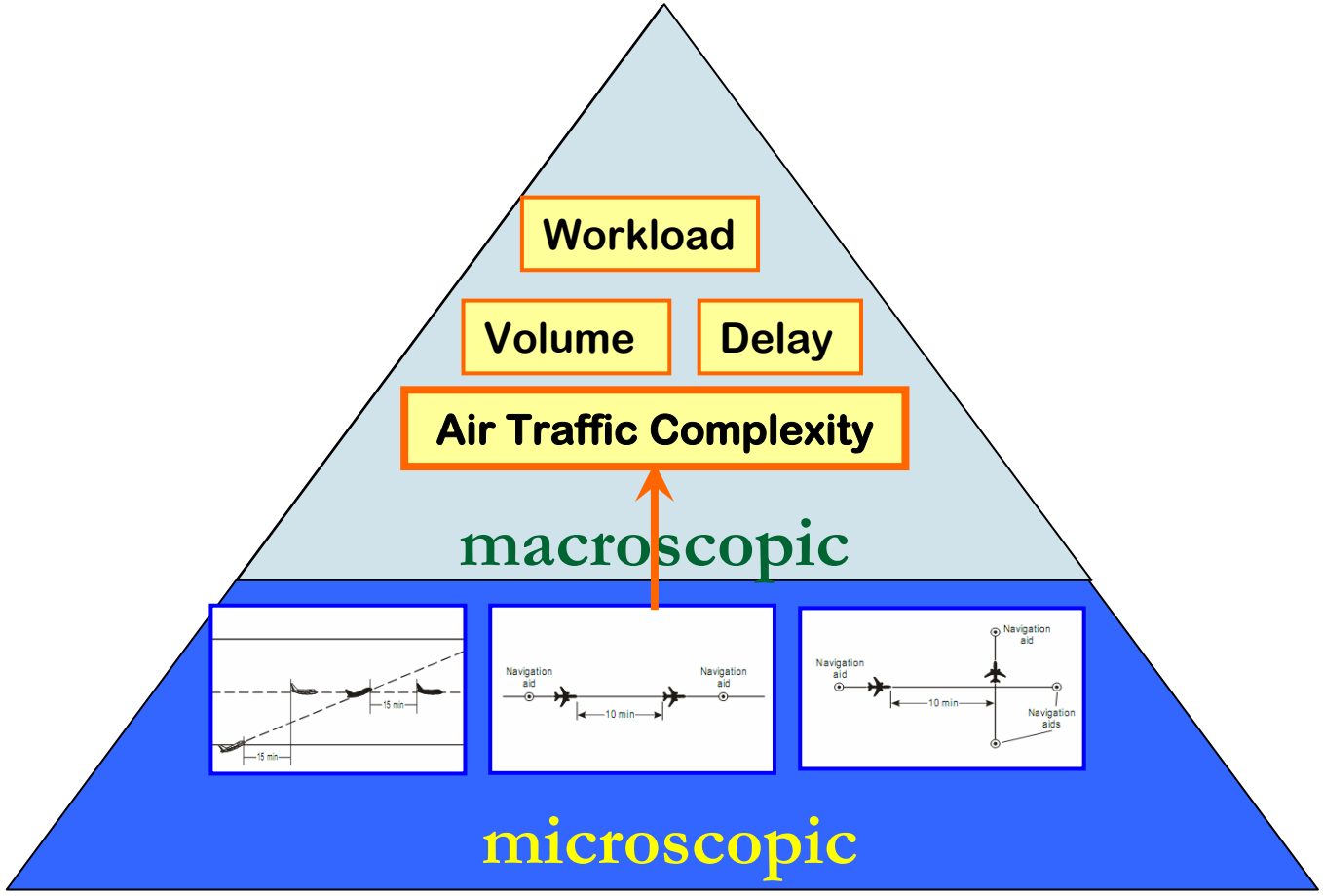
Background

Delay has been used as an alerting index



Background

Indexes to describe Traffic Situation



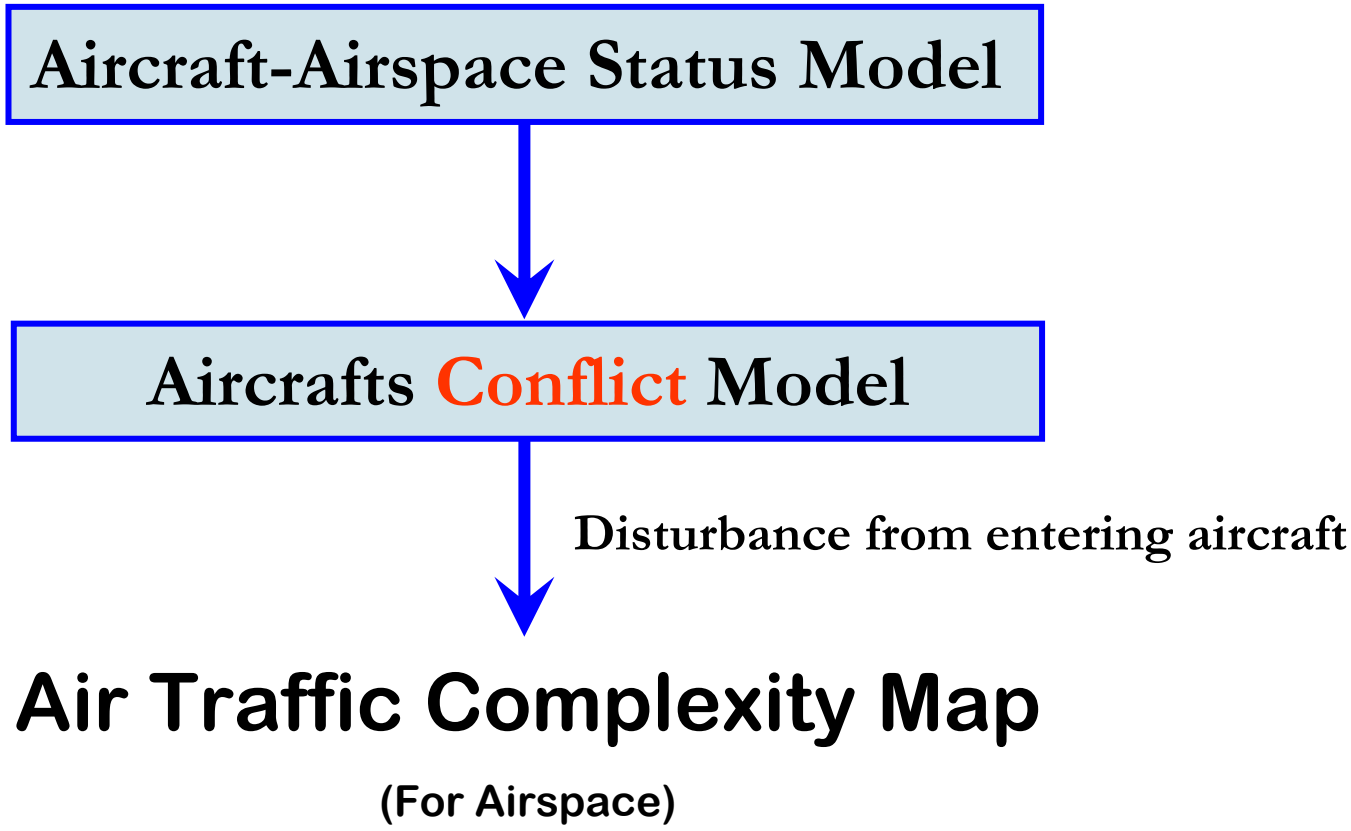
Definition of Air Traffic Complexity

- air traffic complexity is an objective description to the internal order of the air traffic system in certain time or period for a given airspace, sector or route system, which is a synthesis of its airspace structural characteristics and traffic flow characteristics.

HOW TO Demonstrate internal order from macroscopic view?

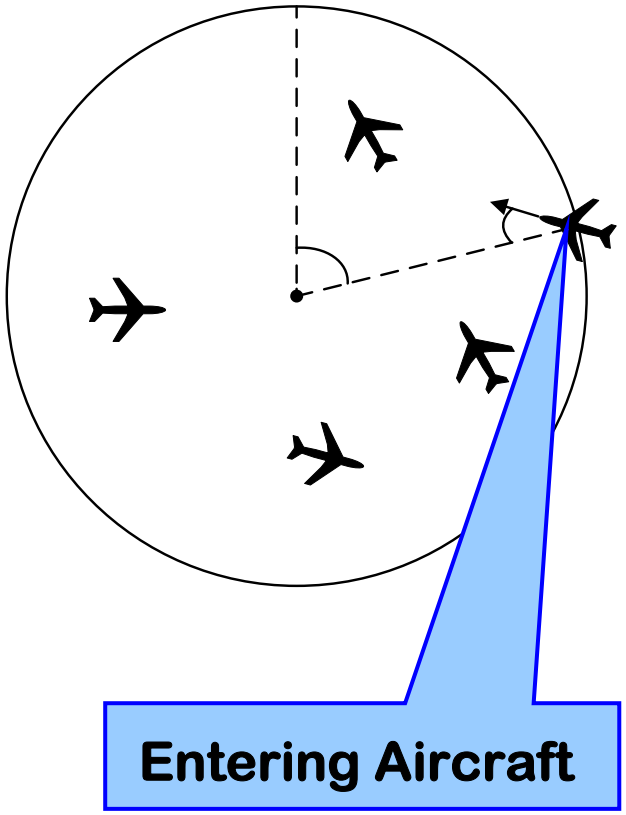
Definition of Air Traffic Complexity

Technical Route

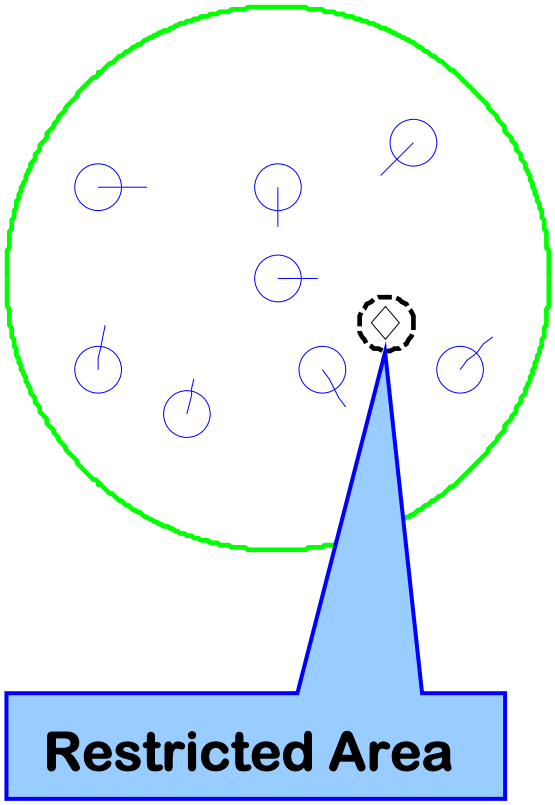


Sector-Aircraft Model

Initial Situation : Conflict Free Sector



Entering Aircraft



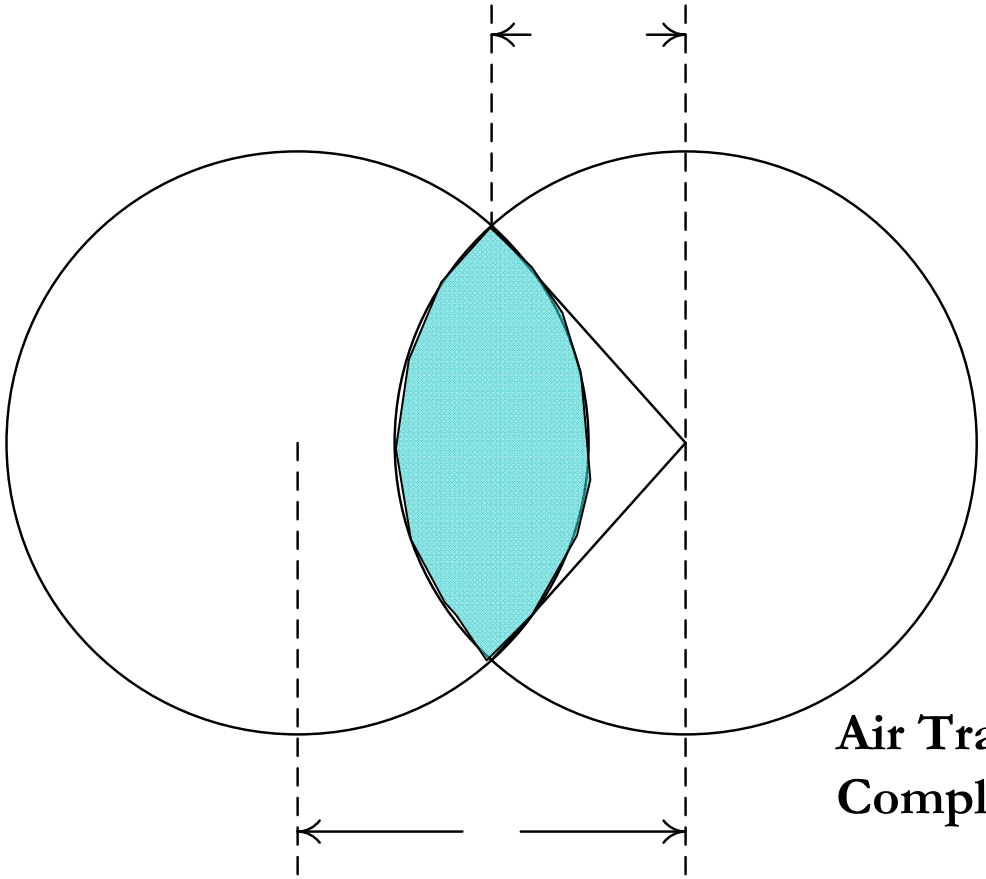
Restricted Area

α

β

Sector-Aircraft Model

Aircrafts Conflict Model



Overlap Area

$$S = [2\arccos\frac{d}{2r} - \sin(2\arccos\frac{d}{2r})] \cdot r^2$$

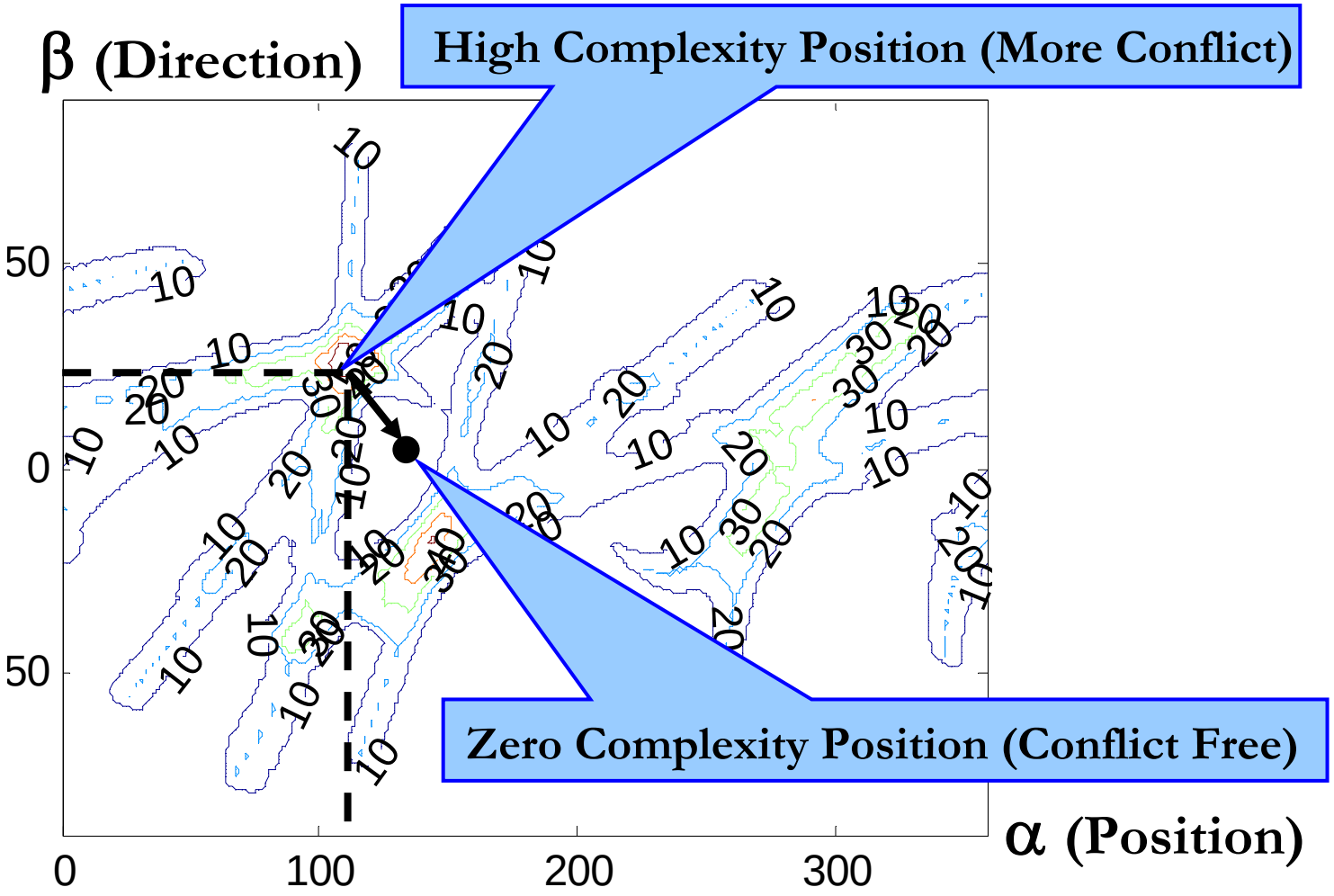
d/2

Air Traffic Complexity

$$TCP = \sum_{i=1}^{N_P} S_i + \sum_{j=1}^{N_O} S_j$$

r

Air Traffic Complexity Map



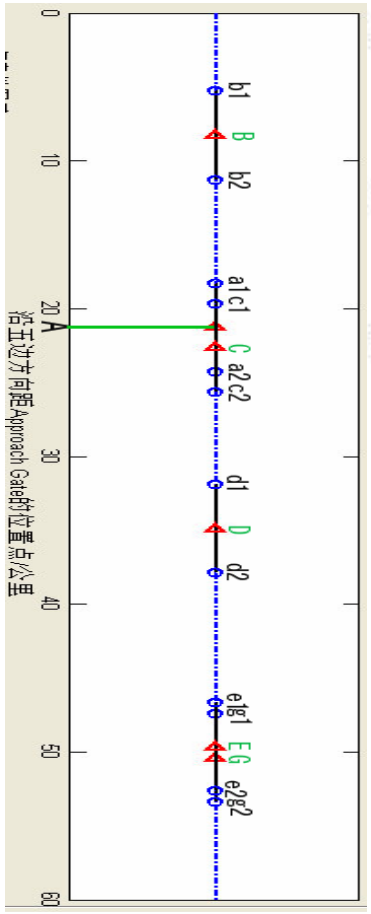
Time Revolution of Complexity Map

Delay	Average of TCP	Peak of TCP	Difference of average TCP compared with Delay=0
0	6.4120	61.1875	
10	6.2724	60.3961	-0.1396
20	6.1261	61.3622	-0.2859
30	6.0169	60.1603	-0.3951
40	5.8984	56.3191	-0.5136
50	5.8020	55.7123	-0.6100
60	5.6973	51.6904	-0.7147
120	4.7027	40.2834	-1.7093

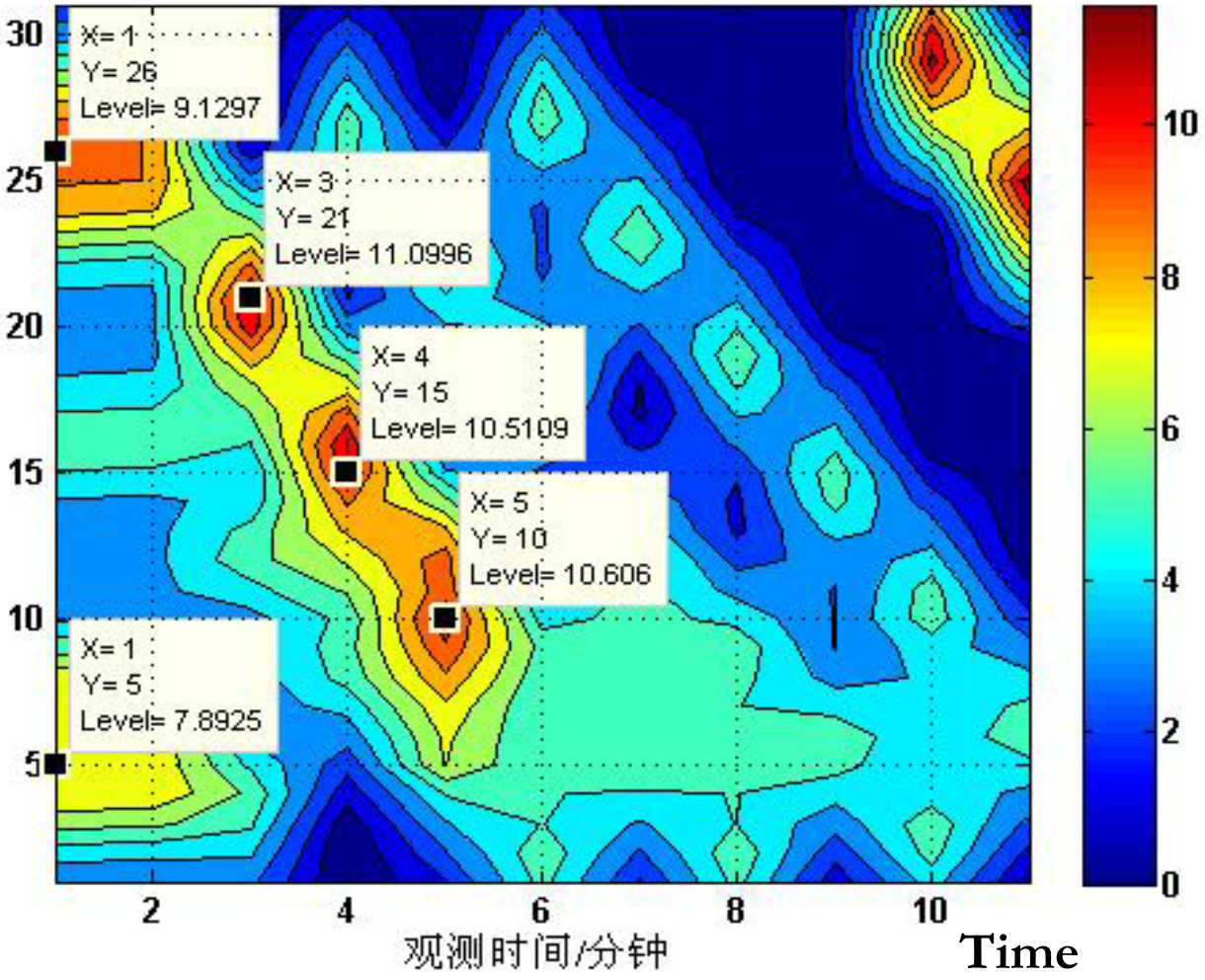
Delay Aircraft Entry time will lead to less conflicts

Application on Final Complexity Analysis

Traffic on Final



Time Revolution of Final Traffic Complexity Map



Thanks

Question?