CNS SG/24– **IP/16**
Agenda Item 6.2
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International Civil Aviation Organization

Twenty-fourth Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/24) of APANPIRG

30 November 2020 - 4 December 2020

Agenda Item 6: Surveillance

6.2 Other surveillance related issues

JAPAN'S EFFORT TO A-SMGCS: DATA-DRIVEN AND SIMULATION-BASED RESEARCH ACTIVITIES ON AIRPORT SURFACE TRAFFIC FLOW

(Presented by Japan)

SUMMARY

This paper presents data-driven and simulation-based research activities on airport surface traffic flow in Japan. Research activities include, 1) analyses of airport surface traffic data (*e.g.* MLAT tracks, gate assignment records, ATC process records), 2) development of surface traffic simulator which is verifiable by actual traffic data, and 3) simulation studies on traffic situation prediction for given taxiway layout and given flight schedules, management method for ground taxiing time, and so on.

1. INTRODUCTION

1.1 Challenges in Airport Surface Traffic

Growth in traffic volume in busy hub airports induces surface traffic congestion, which does not only degrade operational efficiency, but also results in uncertain taxiing times. In order to handle further growth in airport traffic, efficiency measures should be devised so as to manage the schedules of taxiing with regard to the limited capacity of the airport facilities.

1.2 Research Activities in Japan

ENRI (Electronic Navigation Research Institute) is supporting the administrative activities on airport surface management through the following activities;

a) Problem identification based on the actual operational data of airport surface traffic,

b) Development of airport surface traffic simulator, called as "GRACE" (Ground Airplane Control Environment), and

c) Simulation studies on efficiency improvement obtainable by surface traffic management measures.

2. DISCUSSION

2.1 Problem Identification and Simulation Building, Based on Surface Traffic Data

Owing to the advancement in the airport surface surveillance technology, rich data of airport surface traffic flow became available for research. ENRI is analyzing the data to identify the issues to be solved by surface traffic management.

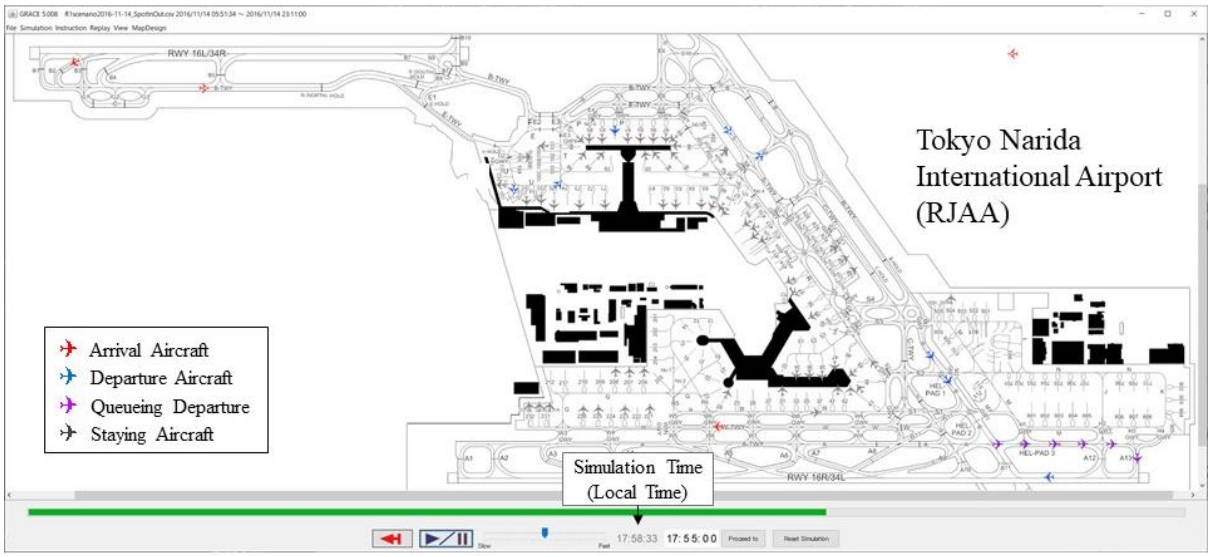
The surface traffic data include the following items to overview the whole processes of airport surface operations;

a) Aircraft position data at every second, obtained by surface surveillance systems (*e.g.* SMR, MLAT),

b) Parking gate assignment records from airport authority (usually, recorded in minutes), and

c) ATC process records (e.g. time of aircraft's "ready" call, time of departure clearance issue), written in ATC tower flight strips, or recorded in datalink such as DCL.

Based on analyses of surface traffic data, ENRI has been developing a surface traffic simulator, called as "GRACE" (GRound Airplane Control Environment), using the knowledge of standard taxiing routes and standard taxiing speeds derived from surface traffic data analysis. Since the simulation on GRACE can be validated and verified using the surface traffic data, GRACE has the capability to compare the actual and simulated traffic situations precisely.



[ENRI's airport surface traffic simulator "GRACE"]

2.2 Simulation Studies on Airport Surface Traffic Management Methods

Since analysis on surface traffic data showed that the increase in traffic volume of departures induces surface traffic congestion, ENRI is studying surface traffic management methods to regulate departures' traffic volume and to stabilize taxiing times, based on surface traffic simulations.

New results of simulation studies obtained so far are explained in the following section.

2.3 New results of simulation studies

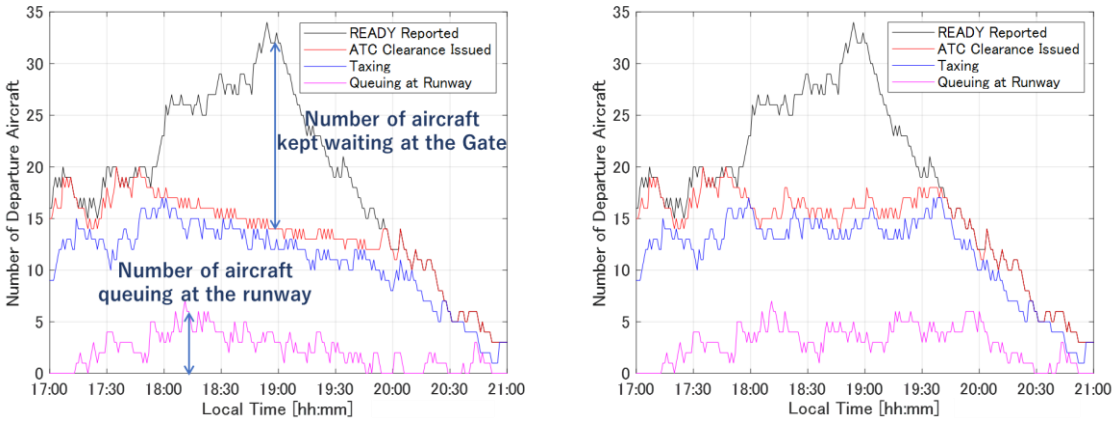
a) Method for managing uncertainty of ground taxiing time

In the time management of air traffic, the time management of the airport surface ground taxiing which becomes a starting point of traffic flow is an important element. In order to mitigate the delay of the taxiing caused by the congestion of the departure flight, the interval setting of the spot departure according to the clearance of the runway is effective. However, since the runway clearance varies from day to day and from time to time because of factors such as weather condition, it is necessary to deal with the uncertainty of the parameters of the separation due to this difference.

With regard to the timing of departure (interval of spot departure time) at a spot to mitigate congestion on departing flights, the uncertainty of taxiing time is minimized in the following cases; when the interval at which the departing flight arrives at the queue at the runway end is set to exactly match the average takeoff interval on the takeoff runway. This is because the length of the queue at the runway end becomes constant. However, since the average takeoff interval is affected by weather conditions (that is “error”), it is difficult to know in advance the ideal takeoff interval (that is “parameter”) in the time zone of the day of the separation.

Therefore, in order to know the ideal interval in advance, the following compensation method was developed to reduce the influence of errors. First, considering that the parameter includes an error, the error of the parameter can be grasped from the tendency of increase or decrease of the number of taxiing aircraft during the interval. Next, the interval between spot departure times is changed at any time in response to an increase or decrease in the number of taxiing aircraft caused by the grasped error. That is, a time interval corresponding to the increase is added and the number of aircraft corresponding to the decrease is simultaneously departed in advance.

Fig. 1(a)(b) shows a comparison of the simulation results when this compensation method is not applied and when it is applied to a departure flight from Narita Airport. In Fig. 1(a), since the compensation method is not applied, the waiting in the spot increases while the queue at the runway end becomes shorter. On the other hand, in Fig. 1(b), by this compensation method, the number of aircraft waiting for takeoff (Magenta line in the figure) at the runway end can be stabilized to a constant value even with the same parameter setting. As a result, it was shown that the uncertainty of the taxiing time of departure flight could be reduced by leveling the waiting time at the runway end.



(a) Compensation method is not applied (b)Compensation method is applied

[Fig. 1 Comparison of the simulation results for the compensation method]

2.4 CONCLUSION

a) ENRI's simulation studies showed that the uncertainty of the taxiing time of departure flight could be reduced by leveling the waiting time at the runway end. This study is oriented to development of surface traffic management measures to enable time based air traffic flow management.

b) These studies, using ENRI's airport surface traffic simulator "GRACE" should contribute to DMAN and SMAN operation, which are key enabler for one of the most important factor in A-SMGCS "Routing". ENRI will continue further studying for efficiency improvement on airport surface traffic flow.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) The Conference is invited to note the information contained in this Paper.

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