

**Twenty Third Meeting of the
Informal South Pacific ATS Co-ordinating Group (ISPACG/23)**

Santiago, Chile, 26-27 March 2009

Agenda Item 4: Review Open Action Items

TAILORED ARRIVALS EXAMINATION OF AIRCRAFT DERIVED DATA

(Presented by Airservices Australia)

SUMMARY

This document is to update ISPACG on the work Airservices Australia is conducting with regard to the examination of the accuracy of aircraft based intent data.

1. INTRODUCTION

- 1.1 As part of the Tailored Arrivals work, Airservices Australia is working with partners including airlines, Emirates, Qantas and Singapore to examine the Intermediate Projected Intent Group (IPIG) information from FANS aircraft with the view to use such Aircraft Derived Data (ADD) in future trajectory based ATC systems. Trajectory Based Operations (TBO) are the objective for initiatives such as NextGen and SESAR.
- 1.2 The requirement for accurate trajectory prediction (TP) is paramount for the concepts promoted for the TBO environment yet the source of the TP has largely been expected to come from ground based sources. This has in part been due to the mechanism of extracting the aircraft intent data not being specified and easily available without significant fitment cost. IPIG has been available since FANS introduction in the early nineties and is a readily available source of ADD however little is known about its accuracy or the factors that influence its output.
- 1.3 When contracted by the ground system, FANS IPIG can provide information within each ADS-C report about the aircraft's FMS intent in the form of bearings and distances with times based upon the current position of the aircraft. These bearings and distances must be converted by the ground system to latitude and longitude before the information can be used, however once converted, the information contained within can be used to examine the accuracy of ADD and external influencing factors.

2 DISCUSSION

- 2.1 The ADS-C data for the study is obtained from flights arriving Melbourne in the early morning which due to the relative low traffic density at the time are highly unlikely to be subject to ATC intervention for the arrival. Coupled with the published runway linked Standard Terminal Arrival Routes (STAR) at the destination, the trajectory of these aircraft can be stable for a significant time prior to destination. Consistent ATC handling of these aircraft permit the extraction and analysis of intent data from these flights commencing two hours prior to destination. To eliminate to the maximum extent possible external variables it was important for the onboard automation to fly the aircraft without human intervention and flight crew were issued with instructions to operate in LNAV VNAV modes allowing the FMS and onboard automation to operate the aircraft as optimally as possible¹. Without ATC or pilot intervention, the ADS-C position reports of these flights form a consistent and valid data set to analyse the downlinked ADD.
- 2.2 To extract the data from these in service aircraft an unmanned duplicate Air Traffic Control system was established to initiate ADS contracts specifically tailored to the data collection via a separate and additional ADS-C connection. The ADS contract for data collection purposes differed from the normal operational contract by an increased reporting rate at 2 minutes plus provision of all possible downloadable data. The high reporting frequency was required to analyse the accuracy and consistency of the Intermediate Projected Intent over subsequent reports.
- 2.3 Data extraction commenced when the aircraft was approximately two hours from destination, typically somewhere around 1000nm to run. The flights were performed by Airbus A340-500 (A345) and Boeing 777-300 (B773) aircraft with Honeywell FMS.
- 2.4 For each participating flight, estimate times of arrival for waypoints enroute, Top of Descent (TOD) and feeder fix were extracted from the aircraft provided intent data. These estimates were subsequently compared to the actual time over to determine the estimate error. Figure 1 gives for a particular flight the estimate error for TOD versus time out of TOD. A positive estimate error ϵ indicates that the estimate made at time t was late compared to actual time over and vice versa. A positive slope $d\epsilon/dt$ at time t indicates that the current trend is estimating towards later arrivals and vice versa.

¹Operating optimally in this context means operating to a flight-specific Cost Index (CI) determined by the AOC to achieve maximum efficiency in overall network operations.

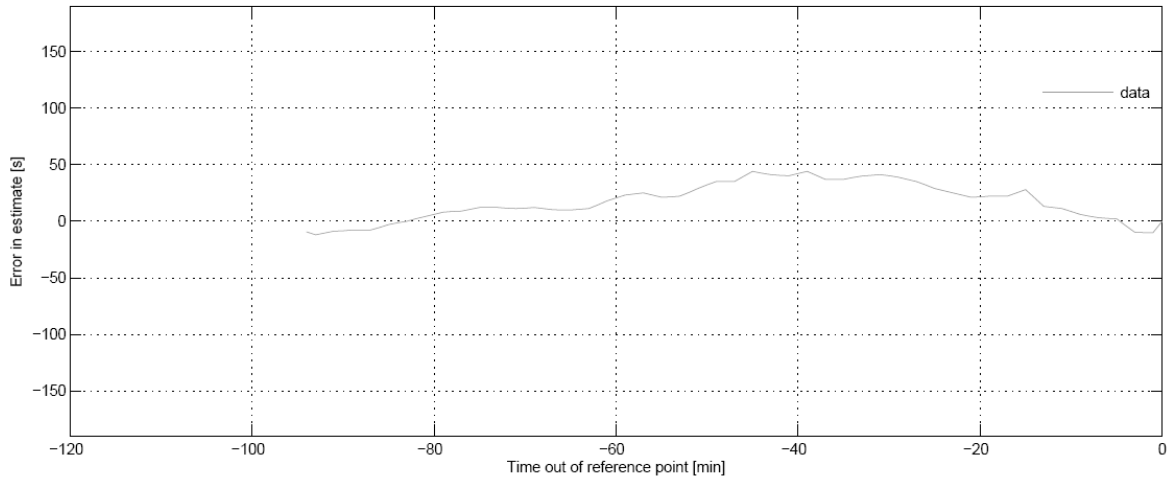


Figure 1 Estimate error for TOD versus time out of TOD (UAE406 20080218)

- 2.5 Figure 2 shows for all A345 flights the estimate error for TOD combined in one graph. The analysis over multiple flights is focused on the determination of the distribution characteristics of the ETA error $e_{AC,p}$ for a specific aircraft type $AC \in \{A345, B773\}$ and for a specific reference point $p \in \{PE, TOD, FF\}$.

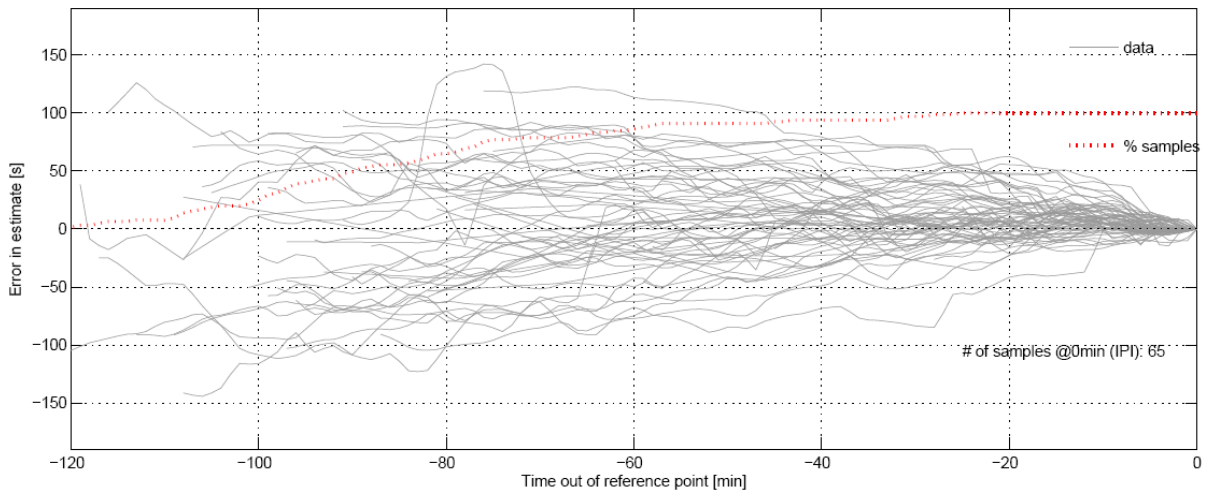


Figure 2 Estimate error for TOD (all A345)

- 2.6 The estimate error $e_{AC,p}$ is distributed in two dimensions: time-out-of-reference-point T_p and error value ε_{AC,p,T_p} . At every time-out-of-reference point the characteristics of the distribution of the error ε_{AC,p,T_p} at that particular time-out-of-reference point can be determined.
- 2.7 Although the aggregated data is only shown here for a single point (TOD) and one aircraft type (A345) the trend to date has shown the possibility of increased accuracy by integrating ADD into the ground systems.

- 2.8 The recent ASPIRE flight from Los Angeles to Melbourne was logged on to the Tailored Arrivals system for the entire flight and in addition to showing reasonable estimate accuracy, the FMS planned vertical profile was also visible to the ground.
- 2.9 Although the FANS IPIG is a good and available means of extracting ADD from the FMS, it suffers from limitations from both the mechanism used for transfer plus the format of the intent data itself. The current work will identify the usefulness of this information along with possible uses and future work will be required to identify the appropriate format of the data and the means of transferring it.

3 ACTION BY THE MEETING

- 3.1 The meeting is invited to:
- a) Note the work conducted by Airservices.
 - b) Support possible future requests for trials and data collection.