Compression on final approach and Time Based Separation for optimized runway delivery

Bologna – Young Scientist Award

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3 December 2015
Overview

- Background
- Characterization analyses
- Verification
- Validation
- Conclusions and deployment
Background

Distance Based Separation (DBS) versus Time Based Separation (TBS)

- Strong Headwind
  - 5NM = 141s
- Low Headwind
  - 5NM = 122s
Background

DBS versus TBS

5NM=122s

4.6NM=122s
Background

Can we better predict the speed profile?

- We are working on solutions maintaining runway throughput in all wind conditions.
- As a first outcome of this process we have looked at “better predictability of the aircraft speed profile” for better predicting the compression between aircraft pairs.
- This produced interesting first descriptive results.
- This is the objective of my study.

To quantify and model the potential performance compression improvements on final approach for the TBS.
Background

TBS concept

- An additional spacing buffer is needed for the follower aircraft for delivering separation minima.
Background

TBS concept

- An additional spacing buffer is needed for the follower aircraft for delivering separation minima.

- This additional buffer is a function of:
  - First order: global deceleration (catch-up)
  - Second Order: Specific time to fly (aircraft type and wind)
Characterization analyses

Radar track data measurement for the 4 parameters

Aircraft Type = A319 and 0-5 kts HW and 472 measurements

- Vapp
- SF
- DF
- Vglide

Stabilization Fix = 3.2 Nm
Deceleration Fix = 5.0 Nm

Background - Characterization analyses - Verification - Validation
Characterization analyses

We know what influence what

- Wind
- Manufacturer
- Vapp
- Wingspan
- Aircraft type
- SF
- Windspeed (SF)
- Airline
- Aircraft type

- Wind
- TAS
- DF
- Wingspan
- Airline
- Aircraft type

- Vglide
- Number of aircraft on the glide
- STAR
- Time of the day

Background - Characterization analyses - Verification - Validation
We know what influence what…

Remember the question:
Can we better predict the speed profile?
  for better predicting the catch up
  for better predicting the separation buffer to consider
    for better predicting the TBS

YES!
Verification

TBS EUROCONTROL vs Floris Friso Herrema (FFH) tool

- Before fixed speed profile
- Flying time for leader and follower were computed using a unique air speed profile (FFH)
We observe a better prediction with the developed advanced mode than with the “original” one.
Comparing the Vapp profiles with Boeing data results shows also good similarities. On average the speed profiles differ between 2 and 5kts.

Vienna radar data shows that the standard deviation for the four parameters differs between 3 and 8%. However the DF and SF is higher 5-10% due to local ILS and IAP procedures.
Validation

What is the purpose of this

- Remember buffer is calculated based on wind, catch up and different speeds on final approach
Validation

Real time simulation

- The speed profile is described by: Vapp, DF, SF and Vglide from this study.

- 2 ATC from Charles De Gaulle and 4 pilots from Air France
Validation

What is the purpose of this

- For providing the ATC with the relevant information
- You need to know expected aircraft behaviour (speed profile)

Compression based on wind and because ATR 72 land a lower speed and reduce earlier than the F100

Background - Characterization analyses - Verification - Validation
Conclusion – Thesis

FFH tool and validation

- Vienna data shows that the standard deviation for the four parameters (Vapp, SF, DF and Vglide) differs between 3 and 8%. Comparing the Vapp profiles with Boeing data results shows also good similarities.

- The FFH tool has been made and can be used for a better understanding of the speed profile and the TBS compression effect between aircraft pairs.

- By comparing the outcome of the TBS FFH tool with real radar flights in both case studies, it turns out that the FFH tool performs better than the TBS EUROCONTROL OSED 1 model.

- Primary results from the validation: 50% throughput recovery can be expected by comparing the low wind with the high wind conditions and applying the new TBS methodology.
Conclusion – Deployment

Together with NATS

- TBS for final approach shall be operated at 16 European Airports by 2024.

- Operationally at London Heathrow this summer 2015 (first TBS airport in the world).
  - TBS is on track to save 80,000 minutes of delay per year at Heathrow.
  - Recovery 2 landings per hour during strong headwinds
  - Benefit to the airlines in the range of 6 to 7.5 million pound per year
Thank you

Any questions?

- With this thesis a better prediction is established of the compression effect on final approach, this research will stimulate further TBS studies....