

Wake Energy Retrieval: an environmental opportunity for aviation

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Wake Energy Retrieval operations in cruise, applied to aeroplanes engaged in international commercial operations, allow significant fuel burn savings and associated CO₂ emission reduction without additional ground infrastructure or aeroplane sensors. The principle relies on an aeroplane harvesting a part of the energy from the wake vortex generated by a leading aeroplane, by actually surfing it. The technical solution ensures that the aeroplanes remain safely positioned throughout the “paired” flight. With trials, fuel savings have been confirmed for over 5% reduction of CO₂ emissions per flight, with relatively limited impacts identified on flight operations.

1. Introduction

This paper describes fello’fly demonstrator advances during transatlantic trials end of 2021, proving technical and operational feasibility.

The value of Wake Energy Retrieval is linked to the local fuel savings obtained for the follower aircraft while surfing the vortex. The principle relies on harvesting a part of the energy from the wake vortex generated by a leading aircraft, by actually surfing it. Whilst wake turbulence is commonly considered as a threat for commercial aeroplanes, this concept aims at taking benefit from the energy contained in trailing vortices, without compromising safety (which is paramount). Thus, positioning a trailing aircraft in a right way in the area where the vortex pushes air upward enables the trailing aircraft to save fuel.

2. Technology

At aircraft level, airborne functions are developed to automatically position and maintain the trailing aircraft in the optimum position near the vortex generated by a lead aircraft, while guaranteeing protection with regard to wake vortex encounters and mid-air collision risks.

3. Trials

In November 2021, a round-trip demonstration flight trial in General Air Traffic was performed from Toulouse (LFBO) to Montreal (CYUL), across the North Atlantic airspace, using Airbus Flight Test A359 MSN1 as Leader A/C and A35K MSN59 as Follower A/C with the fello’fly technology.

These two first transatlantic flights of a pair of aircraft, one surfing the vortex of the other, have been considered a real success. At least 2 tons of fuel (around 6 Tons of CO₂) was saved during each flight. 5% fuel saving efficiency has been confirmed.

Based on CONOPS, Safety studies were performed to manage Wake Energy Retrieval operations in General Air Traffic conditions with legacy ATC procedures and tools. A specific VHF frequency was allocated. Stand-

ard ATC communication was used with a dedicated phraseology defined and shared with involved Airbus Pilots, DSN, NATS, NAVCANADA and IAA Air Traffic Controllers.

Rendezvous and split procedures were experienced. The pair crossed the FIR borders in formation under the coordination of Air Traffic Controllers alongside. Oceanic Clearances have been integrated into the process.

3. Outcomes

With around 75% of the flight time in automatic formation flight (in OPTI mode, refer to CONOPS in Reference section), and a total of 11h20 (round-trip) of automatic positioning, the technical and operational objectives were successfully met and 5% fuel (2 tons of fuel, 6 tons of CO₂) savings were confirmed.

3. Next steps

Collaborations are currently being established with ICAO, Authorities, ANSPs, Airlines to introduce this environmental opportunity to operations. Asia –Pacific Region and traffic provides promising characteristics for Wake Energy Retrieval operations.

Following aspects have to be standardized:

Pilots: Wake Energy Retrieval brings new procedures for rendezvous and split. Cockpit assistance will be provided, together with a specific training

Airlines: Pairing decisions within operation centres and dispatchers has to be smoothly integrated,

ANSPs and Air Traffic Controllers: A level of support is needed, with integration of a pair configuration within the ATC Safety Nets.

References / More information

<https://www.airbus.com/en/innovation/disruptive-concepts/biomimicry/fellofly>