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FAR-Wake
AST4-CT-2005-012238

Start:	01 February 2005
Duration:	36 months
Budget:	3.75 Million Euro
EU support:	1.98 Million Euro
Consortium:	17 organisations in 8 countries

irphé Institut de Recherche sur les Phénomènes Hors Équilibre

> Coordinator contact details

Dr. Thomas Leweke
Institut de Recherche sur les Phénomènes
Hors Equilibre (IRPHE)
Centre National de la Recherche Scientifique (CNRS)
49, rue Frédéric Joliot-Curie - BP 146
F-13384 Marseille Cedex 13
France
Tel.: +33 (0)4 96139761
Fax: +33 (0)4 96139709
E-mail: Thomas.Leweke@irphe.univ-mrs.fr

European Union
6th Framework Programme for Research and Technological Development
Priority 4: Aeronautics and Space

Specific Targeted Research Project

FAR-Wake

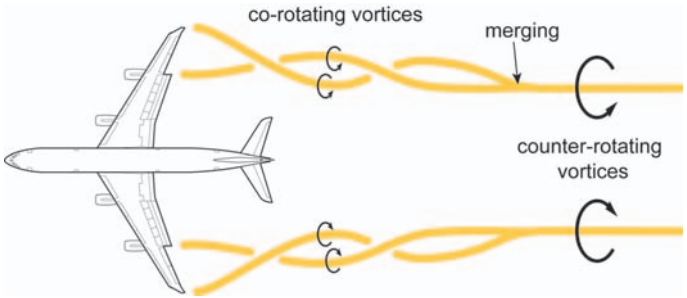
Fundamental Research on Aircraft Wake Phenomena

www.FAR-Wake.org

FAR-Wake

Background <

This project is the continuation of a recent effort, on a European level, to characterize, understand and control aircraft wake turbulence. Aircraft in flight leave behind large-scale swirling flows (vortices), which can represent a significant hazard to following aircraft, and therefore are of great importance for practical applications concerning safety and capacity of air transport.



Vortices in the wake of a civil transport aircraft.

Objectives <

The main objective is to gain new knowledge on unresolved aspects of vortex dynamics relevant to aircraft wakes, and to provide a more systematic description than previously achieved, of the phenomena involved in aircraft wake dynamics. These fundamental developments are necessary to achieve major advances in this domain, in view of a successful application of existing or future strategies for wake characterisation, prediction, and alleviation.

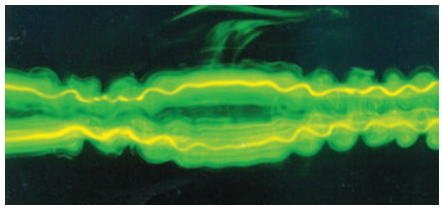
Description of work <

The FAR-Wake project contains four major work packages (WP), in which the following subjects are investigated:

WP1 > Vortex instabilities and decay

> Waves on vortices: vortex meandering, end effects, vortex bursting

> Vortex instabilities: short-wave elliptic instabilities, medium- and longwave instabilities

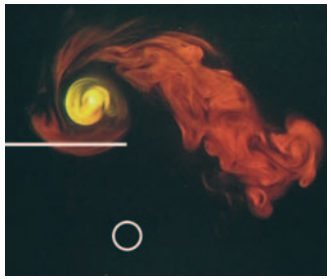


Long- and short-wave instabilities in a vortex pair. Dye visualisation in a water tank.

WP2 > Vortex interactions with jets and wakes

> Jets: cold engine jets, hot engine jets and compressibility effects

> Wakes: fuselage wake, wakes of wing elements (engine nacelle, landing gear, …)



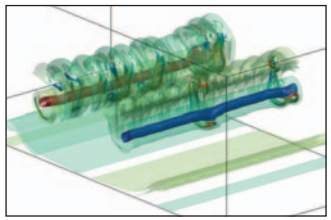
Ingestion of jet turbulence (red) into a vortex (yellow). Dye visualisation in a water channel.

WP3 > Wake evolution near the ground

> Idealised conditions (lab or simulation): uniform and spatially evolving wakes

> Real conditions (including atmospheric effects): data from previous flight tests

> Real-time modelling of vortices in ground effect



Vortex pair in ground effect: instability of secondary vortices. Results from Direct Numerical Simulation.

WP4 > Synthesis and assessment

Methodology <

In the majority of the cases, emphasis is put on the study of simplified geometries and generic vortex configurations, which facilitates the use of different complementary approaches. In support of new experimental and numerical investigations, theoretical/analytical treatment is applied, with the aim of obtaining a systematic description and comprehension of the phenomena. Furthermore, extensive use is made of results and data from previous projects or available data bases. The confrontation and comparison of different sets of results validate the findings and make the description of the studied phenomena more complete. An important effort will be made to provide a synthesis of all the new fundamental results that were obtained, and to assess their relevance for the wake turbulence problem for real aircraft. Certain features found to be promising for the acceleration of wake decay, such as flows with multiple wake vortices, are analysed and tested in a realistic configuration, using numerical simulations and experiments in a large-scale towing tank facility.

Expected end results <

This project will generate systematic results and physical understanding concerning previously unresolved issues related to aircraft trailing wakes, including the role of vortex instabilities, the influence of engine jets and fuselage wakes, and ground effects. This will create a solid knowledge base for future applications aiming at the reduction of wake turbulence hazards. Concerning ground effects, the project will in addition produce improved tools for the real-time prediction of wake vortex behaviour, to be used in the domain of Air Traffic Management. Due to the mostly fundamental character of the research, the results will also be relevant in various other areas of fluid mechanics.