

**A EUROPEAN SYNERGY
FOR
THE ASSESSMENT OF WALL TURBULENCE.**

PROJECT N°: AST4-CT-2005-516008

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Why Near Wall Turbulence?

The world is entering a new age of aviation --- the age of sustainable growth --- characterized by the need for more affordable, cleaner, quieter, safer and more secure air travel. European aeronautics is committed to play a prime role in shaping aviation for this new age. Research and technology development will be essential in responding to this challenge. To do so, Europe needs upstream research to further improve the technology base and to develop innovative concepts and breakthrough technologies, thereby paving the way for a step change in aviation.

In the near future, Europe seeks to reduce significantly aircraft development and operating costs. To do so, the aeronautical industry will need improved models based on a deeper understanding of the physics, and acquired using the most advanced experimental and modeling methods. While this is true for all the aspects of the design and operation of an aircraft, it is particularly true for aerodynamics. Although aerodynamics has made tremendous progress in the last century, it still lacks reliable turbulence models (which are crucial also for many other industrial design problems) and the understanding to develop them. The search for these models remains a very active domain for research and improvement. In fact, turbulence remains one of the great unsolved riddles of engineering and natural sciences, nowhere more so than near surfaces.

The potential benefits from even modest gains in understanding and predictive ability can best be illustrated by a simple example. On an Airbus A340, approximately one-half of the drag at cruising speed is skin friction drag. Based on Airbus estimations, even a 10% reduction of this drag would result in a fuel saving of about 100,000 Euros per aircraft per year, or 1 billion Euro saving over the world every year. In practice, it is the inner part of the boundary layer nearest the wall that is crucial in determining the skin friction drag and, in fact, it is in this region that the present turbulence models are the least reliable, most notably when the flow is close to separation or separated. Therefore, a better understanding and modelling of this region, which is fairly universal, is crucial - first to have reliable estimations a priori of the drag of a new aircraft design and - second to move toward intelligent control strategies of the near wall flow.

Which Team?

The WALLTURB consortium is composed of 16 partners (Table 1). This consortium includes high level industrials from Aeronautics, large public research organizations and well known Universities from the Mechanical Engineering and Aeronautical field. All partners are strongly involved in the research on turbulence at European and International level. They have proven their efficiency and ability to cooperate in the frame of previous European programs.

LML UMR CNRS 8107	F
ONERA	F
LEA UMR CNRS 6609	F
LIMSI UPR CNRS 3251	F
Chalmers University of Technology	SE
ENSTA/ARMINES	F
CNRS SPEC/CEA Saclay	F
University of Cyprus	CY
University of Rome la Sapienza	IT
University of Surrey	UK
Polytechnic University of Madrid	SP
Technische Universität München	G
Technical University of Czestochowa	PL
Norwegian Defence Research Establishment	NO
AIRBUS	UK
DASSAULT AVIATION	F

Table 1 : List of WALLTURB partners

What Objectives?

The WALLTURB project is a challenging research program, completely in the objectives of the FP6 in Aeronautics and of strong industrial interest at intermediate and long term.

The global aim of WALLTURB is to bring in four years a significant progress in the understanding and modelling of near wall turbulence in Boundary Layers. This goes through:

- generating and analyzing new data on near wall turbulence,
- extracting physical understanding from these data,
- putting more physics in the near wall RANS models.
- developing better LES models near the wall
- investigating alternative models based on Low Order Dynamical Systems (LODS).

For that purpose, the WALLTURB Consortium plans :

- to put in a common database, shared by the WALLTURB partners, who are all experts in turbulence, the existing relevant data they have about near wall turbulence (from both experiments and DNS),
- to generate by experiment, and by complementary DNS, equivalent data for the Adverse Pressure Gradient Turbulent Boundary Layer physics (including separated flow cases), and to put them in the common database,
- to use this database to improve near wall turbulence models such as RANS, LES and LODS, and especially to understand their relative strengths and weaknesses.

Which program?

To reach the above objectives, the WALLTURB Consortium will take advantage of :

- the recent progress in the experimental and numerical approaches of turbulence,
- the complementary skills of leading teams in Europe working on turbulence.

It will generate a large and original database, with recent and relevant data about near wall turbulence (from both experiments and DNS already available at the partners). This database will be shared by the partners to extract relevant physical data.

The consortium will also generate new experimental and DNS data, allowing to assess Adverse Pressure Gradient Turbulent Boundary Layer physics, with and without separation, to go in the common database.

This database will be extensively used by all the partners to improve RANS, and LES near wall turbulence models and to develop a LODS/LES coupling near the wall.

The work performed will allow to make available new turbulence models based on a detailed physical characterisation and to assess the relative merits and drawbacks of these models. These models will be assessed by two leading industrial in the field of aeronautics : AIRBUS and DASSAULT AVIATION.

The WALLTURB project is organized in 6 work packages, as summarized in table 2 :

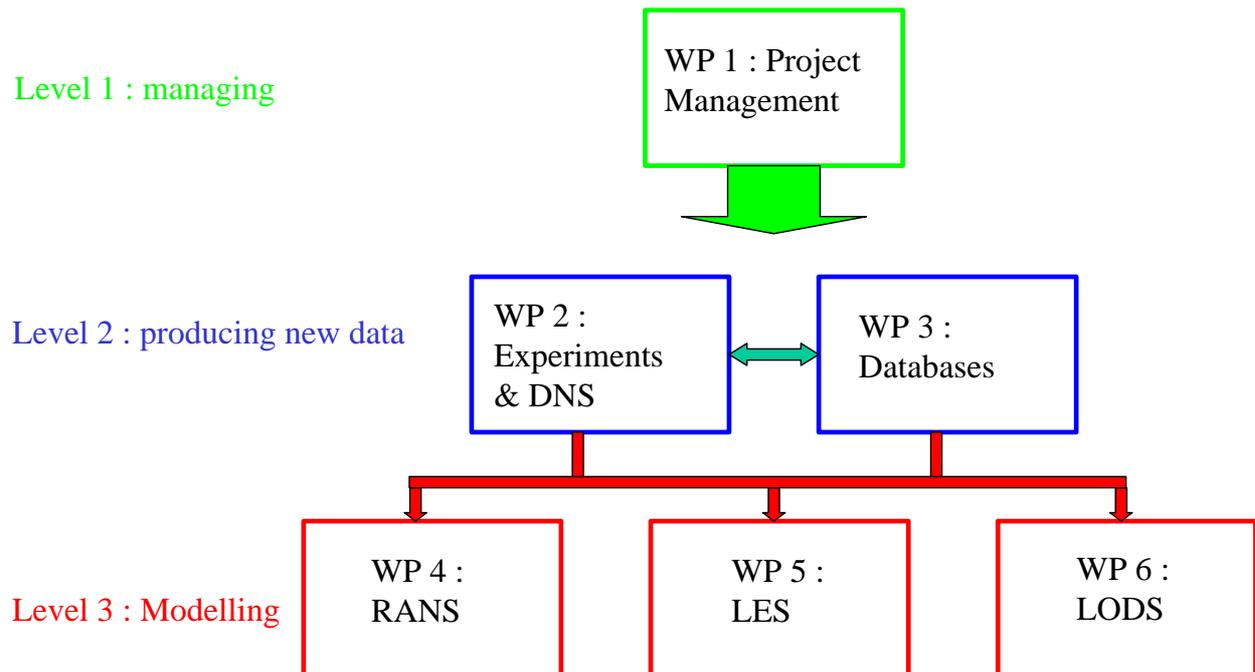


Table 2 : Work program Structure

What is new?

The WALLTURB consortium has organized on March 22-23 2007 in Viterbo (Italy), an open workshop to inform the European research and industrial community of the progress done after two years. The presentations done at this workshop summarize fairly well the WALLTURB status. They can be downloaded from http://ftp.univ-lille.fr/stan/wallturb_viterbo.zip.

What next?

This news letter appears once a year. The next issue is planned in June 2008.

A final open workshop will be organized by the WALLTURB consortium in 2009, to present the main results of the project.