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Assessment of advanced numerical diagnosis on the base of non-intrusive measurements in lean combustion. Application on understanding and design of lean combustion technologies:

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Objectives :

Air traffic is rapidly increasing today and projections estimate it will have doubled by 2020 (4,1% average growth per year until 2020 estimated at CAEP6-2004). Against this background, it is essential to consider the environmental impacts of aviation to ensure in advance that such a rate of development is sustainable. The report of the European group of personalities "European Aeronautics: a vision for 2020" and the related Strategic Research Agenda (SRA - first release issued in November 2002) of the Advisory Council for Aeronautics Research in Europe (ACARE) have set reduction targets of 50% in CO_2 and of 80% in NOx for 2020.
Whereas the reduction in CO_2 will mainly be achieved by improvements in engine efficiency and aircraft performance characteristics, NOx and others species such as CO, UHC and particulate emissions can be significantly reduced by focusing on combustor technology, in particular by introducing new concepts for injection systems. The Specific Targeted Research **TLC** Project participates to those objectives by:

- investigating more revolutionary technology to meet the challenging ACARE objectives
- developing high-quality non-intrusive measurement techniques
- improving physical knowledge and calibrating CFD tools on the base of high characterized new technologies.

Applications :

Taking advantage of all the knowledge gained in previous European or national projects, the **TLC** project will permit to achieve maturity in the development and design of lean injection systems with fuel staging for single annular combustors.

Evaluation of various concepts, use of design optimisation procedures, large number of tests, development and application of advanced experimental diagnosis for realistic combustor conditions, strong support of numerical diagnosis with the latest European CFD tools, will contribute to this goal.

Results:

The measurements concern various issues of the understanding of the system performances : Spray characterisation, pre-mixing, pre-vaporisation, combustion process and efficiency, NOx emissions, particulates, radiation, lean extinction limit.
Recent techniques for the flame characterisation have been adapted and measurements have been performed up to 20 bars (OH and kerosene LIF, CARS of CO2 and PLIF for temperature measurement).
Most of experimental results give crucial inputs which are used to validate recent models developed within others previous European Research Programmes.

Concerning the optimisation of the lean injection systems, a successful completion of the optimisation of a new injection technology has been realised. It is based on a design of experiment which contains more than 500 2D-CFD simulations. An important numerical work has been also performed to study the new combustor concept TVC.