General Introduction

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1 General Introduction

A few years ago the Helmholtz Association (HGF) consisting of 15 research Institutions including the German Aerospace Center (DLR) started a network research program called 'Virtual Institutes'. The basic idea of this program was to establish research groups formed by Helmholtz research centers and universities to study and develop methods or technologies for future applications and educate young scientists. It should also enable and encourage the partners of this Virtual Institute after 3 years funding to continue their cooperation in other programs. Following this HGF request and chance the DLR Windtunnel Department of the Institute of Aerodynamics and Flow Technology took the initiative and established a network with the following partners:

- DLR Windtunnel Department of the Institute of Aerodynamics and Flow Technology in Cologne (Dr. Ali Gülhan)
- DLR Space Launcher Systems Analysis Department of the Institute of Space Propulsion (Dr. Martin Sippel)
- DLR Space Structural Components Department of the Institute of Structures and Design (Dr. Hermann Hald)
- Institute of Aerodynamics, RWTH Aachen (Prof. Wolfgang Schröder)
- Shock Wave Laboratory, RWTH Aachen (Prof. Herbert Olivier)
- Transition Group of the Institute of Aerodynamics and Gasdynamics of the University of Stuttgart (Dr. Markus Kloker)
- Turbulence Simulation Group of the Institute of Aerodynamics of the TU Munich (Prof. Rainer Friedrich)

In order to perform the cooperation efficiently, the research work has been carried out in a project form and with a reference concept. The main goal was to share the experience in system analysis, aerodynamics and material science for aerospace for improving the understanding and applicability of some key technologies for future reusable space transportation systems. Therefore, the virtual institute was named RESPACE (Key Technologies for Re-Usable Space Systems).

The feasibility of future space transportation systems with respect to technical and economical aspects strongly depends on the decrease of the safety margins, i.e. mass reduction, manufacturing and maintenance costs. In addition, the reliability of space vehicles has to be improved. This challenging goal can only be achieved by a realistic

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system study accompanied by developments of key technologies using reliable tools with a multidisciplinary approach. Since the duration of the project was limited to three years, the activities focused on three areas:

- System study to define the technology requirements of the reference concepts,
- active cooling technologies for space transportation systems,
- base/nozzle flow phenomena of a reusable booster configuration.

To achieve these goals first the improvement of numerical and experimental tools was necessary. As leading concepts the Liquid Fly Back Booster (LFBB), which has been one of the basic concepts of the German National Space Transportation Technology Development Program ASTRA, and the new SpaceLiner vehicle defined by the DLR department for Space Launcher Systems Analysis were chosen.

For the two technological topics dealing with active cooling of hot structures and base flow phenomena of booster configurations data were accomplished by combined application of experimental and numerical tools. A multidisciplinary approach was required for these tasks, which needs basic work to improve the physical modelling of numerical codes and applied research for the design and manufacturing of ground testing models for the qualification of above mentioned key technologies.