a) Scientific Committee

J. Delery (France), J. Fulker (UK), M. Hafez (USA), N. Hirose (Japan), A. Kluwick (Austria), A. Kuzmin (Russia), K. Moffatt (UK, IUTAM), H. Sobieczky (Germany, Chair), Z. Zhu (China).

b) Short summary of scientific progress achieved

This Symposium was the 4th in a series during the last 40 years, showing proof of continuing importance of transonics for aerospace and turbomachinery applications. With theory and modelling well understood in steady flow, progress has been achieved in unsteady flow and its application in aeroelastics. New concepts in viscous - inviscid interaction and flow control were presented suggesting the development of adaptive configurations. The status of wind tunnel testing at high Reynolds numbers was documented.

With operational methods for controlling flows with reduced shock waves, the focus of new work shifts toward strategies for design and optimization of aircraft in the transonic and the high speed regime. Supersonic aircraft design is influenced by the transonic flight phase and sonic boom control requires the understanding of shock waves interacting with transonic phenomena. Finally, results for transonic effects in multiphase flows have been presented, with consequences for applications in turbomachinery component development.

The symposium has demonstrated that with advanced computers and flow analysis software available our refined knowledge base can be used for a faster and more systematic development of new generation aircraft and turbomachinery components.
c) Countries represented and number of participants

Austria (2), Brasil (1), China (2), Czech Rep. (7), France (7), Germany (22), India (1), Japan (2), Netherlands (1), Poland (1), Russia (1), UK (5), USA (12)

d) Publication of Proceedings of the Symposium


e) Financial supports

The symposium was funded by

- DLR German Aerospace Center (host)
- IUTAM
- Kluwer Academic Publishers

f) Scientific program

1. Inviscid flow models

Steady flows
Zierep, J.: New Results for the Normal Shock in Inviscid Flow at a Curved Surface
Hunter, J.K., Tesdall, A.M.: Transonic Solutions for the Mach Reflection of Weak Shocks
Kuz'min, A.G.: Interaction of a Shock Wave with the Sonic Line
Prasad, P.: Upstream Propagating Curved Shock in a Steady Transonic Flow
Hafez, M.: Non-Uniqueness in Transonic Flows

Unsteady flows
Caughey, D.A.: Unsteady Transonic Flow past ,Non-unique" Airfoils
Bur, R., Berthouze, P.: Forced Oscillation of a Shock-Wave in a Transonic Channel Flow

Aeroelastics
Ballmann, J., Boucke, J., Braun, C.: Aeroelastic Sensitivity in the Transonic Regime
Liu, G.-L.: A Unified Variational Formulation of Aeroelasticity Problem for Coupled 'Fluid-Wing' Vibration System in 3-D Unsteady Transonic Flow

2. Viscous flows

Viscous-inviscid interaction
Delery, J.M.: The Different Facets of an Old but Always Present Concern: Shock-Wave/Boundary Layer Interaction
Kluwick, A., Braun, S., Gittler, P.: Transonic, Laminar High Reynolds Number Flow in Slender Channels
Ryzhov, O.S., Bogdanova-Ryzhova, E.V.: Boundary Layer Instabilities in Transonic Range of Velocities
Zierep, J., Bohning, R., Doerffer, P.: Perforated Plate Aerodynamics for Passive Shock Control

Internal flows
Dvorak, R.: Internal Transonic Flows
Safarik, P., Luxa, M.: Transonic Flow past Plane Cascades: Experimental Data Analysis
Dobes, J., Fürst, J., Fort, J., Halama, J., Kozel, K.: Numerical Simulation of Transonic Flow in Steam Turbine Cascades - the Role of Numerical Viscosity, Grid Type and Approximation of Boundary Conditions

**Experimental techniques**
Hefer, G.: *ETW - A Facility for High Reynolds Number Testing*
Meier, G. E. A., Stasicki, B.: *Density Measurement of Large Scale Transonic Flow Fields*

**3. Numerical methods**

**CFD new analysis and design approaches**
Hirose, N.: *Transonic Aerodynamics Research Retro- and Prospective in Japan*
Bramkamp, F., Ballmann, J.: *Implicit Euler Computations on Adaptive Meshes for Steady and Unsteady Transonic Flows*
Eberle, A.: *Efficient and Refined Transonic Flow Analysis Using a New Flux Vector Splitting Scheme*
Fort, J., Fürst, J., Jirasek, A., Kladrubsky, M., Kozel, K.: *Numerical Solution of 2D and 3D Transonic Flows over an Airfoil and Wing*
Hafez, M.: *Alternative Formulations for Transonic Flow Simulations*
Rachwalski, J., Magagnato, F., Gabi, M.: *The Buffer Layer Technique Applied to Transonic Flow Calculations*

**Design and Optimization tools**
Li, P., Om, D.: *Design Applications in the Industry*
Holst, T.L., Pulliam, T.H.: *Transonic Wing Shape Optimization Using a Genetic Algorithm*
Jameson, A.: *Optimum Transonic Wing Design Using Control Theory*
Zhu, Z.: Computation of Biobjective/Bidisciplinary Optimization

4. Flow control and adaptive configurations

Flow control
Fulker, J.L.: A Review of Research at QinetiQ on the Control of Shock Waves
Tulita, C., Raghunathan, S., Benard, E.: Control of Transonic Periodic Flow on NACA 0012 Aerofoil by Contour Bumps
Corre, C., Renaud, T., Lerat, A.: Transonic Flow Control Using a Navier-Stokes Solver and a Multi-Objective Genetic Algorithm

Adaptive Configurations
Geißler, W., Koch, S.: Adaptive Airfoil
Trenker, M., Hannemann, M., Sobieczky, H.: Surface Parameterization for Configuration Adaptation

5. Supersonic flows

Supersonic Transport Design Aerodynamics
Matsushima, K., Yamasaki, W., Nakahashi, K.: Transonic Design of SST - To Employ Japanese SST as a Candidate for Near Sonic Transport
Sobieczky, H., Li, P., Seebass, R.: Transonic Methods for Oblique Flying Wing SST

Sonic Boom: Analysis and Optimization
Cheng, H.K., Hafez, M.M.: The Superboom as a Tricomi Problem: Extensions and Applications
Coulouvrat, F., Marchiano, R., Thomas, J.-L.: Numerical and Experimental Simulation of Sonic Boom Focusing
Argrow, B., Farhat, C., Maute, K., Nikbay, M.: Linear-Theory-Based Shape Optimization for Sonic Boom Minimization
6. Real gas effects

**Multiphase flow**
Schnerr, G.H., Goodheart, K.: *Unsteady Nonadiabatic Transonic Two-Phase Flow*

**Dissociation**

*Report composed by Helmut Sobieczky*