02-7 IUTAM Symposium on Transsonicum IV, Göttingen, Germany, September 02 – 06, 2002

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

A Book "Symposium Transsonicum IV" with 55 contributions and ~400 pages will be published by Kluwer Academic Publishers in 2003.

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*
Liu, D.D., Mignolet, M.: *Transonic Wedge / Cone Flow Solutions Using Perturbed Potential and Euler*
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*

Tang, L., Liu, D.D., Chen, P.C.: *Nonlinear Aerodynamic Effects on Transonic LCO Amplitude of a Supercritical Airfoil*
Schwamborn, D., Weinman, K.: *On the Influence of Turbulence Modelling on Steady and Unsteady Flows*

Aeroelastics
Ballmann, J., Boucke, J., Braun, C.: *Aeroelastic Sensitivity in the Transonic Regime*
Castro, B. M., Jones, K. D., Platzer, M. F., Weber, S., Ekaterinaris, J. A.: *Numerical Investigation of Transonic Flutter and Modeling of Wind Tunnel Interference Effects*
Chen, P.C., Liu, D.D.: *Efficient Transonic Method for Aeroelastic Applications Including Aircraft/Stores*
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*
Jones, K.D., Platzer, M.F., Rodriguez, D.L., Guruswamy, G.: *On the Effect of Area Ruling on Transonic abrupt Wing Stall*
Kluwick, A., Braun, S., Gittler, P.: *Transonic, Laminar High Reynolds Number Flow in Slender Channels*
Ruban, A.I., Türkyilmaz, I., Buldakov, E.V.: *Viscous-Inviscid Interaction and Boundary-Layer Separation in Transonic Flows*
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*

Gerolymos, G.A., Vallet, I.: *Reynolds-Stress Modelling for Transonic Shock-Wave/Boundary-Layer Interaction*

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*

Rein, M., Erdi-Betchi, A., Klinkov, K.V.: *Transonic Flow Phenomena of the Cold Spray Deposition Process*

3. Numerical methods

CFD new analysis and design approaches

Jameson, A., Caughey, D.A.: *Development of Computational Techniques for Transonic Flows: An Historical Perspective*

Hirose, N.: *Transonic Aerodynamics Research Retro- and Prospective in Japan*

Bramkamp, F., Ballmann, J.: *Implicit Euler Computations on Adaptive Meshes for Staeady 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*

Daumas, L., Dinh, Q.V., Kleinveld, S., Roge, G.: *How to Take in Account Deformation in a CAD-Based Euler Optimization Process?*

Holst, T.L., Pulliam, T.H.: *Transonic Wing Shape Optimization Using a Genetic Algorithm*

Jameson, A.: *Optimum Transonic Wing Design Using Control Theory*

Lutz, T., Sommerer, A., Wagner, S.: *Parallel Numerical Optimisation of Adaptive Transonic Airfoils*

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*
Smith, A.N., Babinsky, H., Fulker, J.L., Ashill, P.R.: *Experimental Investigation of Transonic Airofoil Shock / Boundary Layer Interaction Control Using Streamwise Slots*
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*
Nadarajah, S.K., Kim, S., Jameson, A., Alonso, J.J.: *Sonic Boom Reduction Using an Adjoint Method for Supersonic Transport Wing-Body Configurations*

6. Real gas effects

Multiphase flow

Put, A., Kelleners, P.H., Hoeijmakers, H.W.M.: *Development of a Numerical Method for Simulating Transonic Multiphase Flows*

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

Dissociation

Hornung, H.G., Leyva, I.A.: *The Sonic Line and Shock Detachment in Hypervelocity Cone Flow*

Report composed by Helmut Sobieczky