

Please send this report to the Secretary of the European Mechanics Council, Professor Bengt Lundberg, Dept of Mechanical Engineering, Luleå University of Technology, S-951 87 Luleå, Sweden, one month after the Colloquium

General

EuroMech Colloquium No: 274

Title: Internal High Speed Flows with Viscous/Inviscid Interactions

Chairmen: R. Dvořák (CS-Prague), G.E.A.Meier (D-Göttingen)

Place and country: Prague, Czechoslovakia

Dates: 8 - 11.4. 1991

Finance

Renting the Conference rooms, Colloquium banquet, all lunches, Colloquium dinner, Concert, Book of abstracts, refreshment (coffee),

The conference fee 200 USD included

Funding: No fund were available

Accommodation (type and cost): Hotels (from 300 Kčs to 900 Kčs/night)

Meals: Lunches (incl. in the Coll. fee) were served in a restaurant attached to the Conference Hall, 2 other dinners were also covered by the Colloquium fee

Participation

Total number of participants: 45 Distribution of participants by country:

Code	Country	Number	Code	Country	Number
A	Austria	<u> </u>	I	Italy	<u>3</u>
B	Belgium	<u>1</u>	IRL	Ireland	<u> </u>
BG	Bulgaria	<u> </u>	N	Norway	<u> </u>
CH	Switzerland	<u> </u>	NL	Netherlands	<u> </u>
CS	Czechoslovakia	<u>18</u>	P	Portugal	<u> </u>
D	Germany	<u>10</u>	PL	Poland	<u>4</u>
DK	Denmark	<u> </u>	R	Rumania	<u> </u>
E	Spain	<u> </u>	S	Sweden	<u>1</u>
F	France	<u>4</u>	SF	Finland	<u> </u>
GB	Great Britain	<u>1</u>	YU	Yugoslavia	<u> </u>
GR	Greece	<u> </u>	SU	Soviet Union	<u>2</u>
H	Hungary	<u> </u>	-	Others	<u>1</u>

Is there need of another colloquium on the same subject? Which year? It has been decided to hold a bigger Int.Conf. in 1993 in Prague (the 2nd ISAIF Conference) which will cover the same sort of problems.

Scientific Report

About 60 papers were offered in response to the First Call for Papers, however, only 29 were finally presented at the Colloquium. The withdrawn papers (mainly for financial reasons) were from Soviet Union, India and USA. The total number of participants was 45.

Most of the papers presented observed the topics of the Colloquium, though not all topics were equally represented.

Two survey papers were presented at the beginning /1/, /2/. Prof. Meier's general lecture on 3D effects in corner flows was based mainly on original contributions of the DLR in Göttingen. It has, however, clearly defined some of the main experimental, as well as physical problems to which the Colloquium was devoted. In the discussion which followed Dvořák demonstrated the effect of channel width which changes not only quantitatively but even qualitatively the shock wave boundary layer interaction. Analysis of similar experiments by Dvořák and Doerffer /3/ /25/ has shown the role of geometry depending secondary flows in shock wave boundary layer interaction in a closed curved channel.

Prof. Bogdonoff opened a lively discussion on instrumentation used in this field, namely about its applicability, response to the phenomena measured and its effect on the phenomena measured. Some of the problems were clearly demonstrated in the subsequent Prof. Bogdonoff's lecture /2/ on shock wave boundary layer interaction in passages typical of supersonic compressor inlets. He demonstrated how the currently used techniques indicate steady flows (e.g. in viscous dominated flows), in highly unsteady pressure dominated vortical flows.

These lectures and discussions concentrated on one of the most important problems in this field - shock wave boundary layer interaction in closed channel, i.e. in 3D internal flows.

New results in this field appeared also in papers by Doerffer /3/, Dvořák /25/ and Schnerr /14/. Doerffer discussed some phenomenological results concerning -shock waves - typical of transonic flows in highly curved channels, Dvořák discussed mainly the stability of the supersonic inlet-like interaction of a detached front shock wave with boundary layer on a neighbouring wall (profile). The paper by Schnerr opened a new and very important group of more complex problems in which a further parameter enters the solution of interaction - in this case the heat addition from homogeneous condensation inside the boundary layer.

There was an interesting group of papers concerning the high speed 3D flow in cascades, namely at off design conditions when the typically viscous effects are more pronounced. Cyrus has shown how the large separated regions affect the aerodynamic loading and losses in compressor cascades, Mašek discussed the effect of turbine cascade geometry on secondary losses, Sieverding discussed the physics of unsteady processes (incl. vortex shedding) in turbine blades. The unsteady processes are almost inherent to high speed flows and some of their other aspects were incorporated in papers by Sellarowicz and Szumowski //10/, Vlček /11/, Schröder /9/. Especially the latter author demonstrated an excellent piece of experimental technique having used flush mounted hot films to indicate transition and separation in a multistage rotating turbine.

A group of papers on computational fluid dynamics demonstrated the ability of modern computational procedures in solving even highly complicated and complex problems of internal aerodynamics including viscous flow and turbulent effects.

There was a small group of singular papers, that, nevertheless, met a good response.

Maršík /16/ applied results of the thermodynamic theory (namely the principle of maximum entropy) to the stability analysis of highly complex viscous flows typical of internal transonic aerodynamics. Leblanc et al. studied the behaviour of a transonic jet injected normally from the surface into a transonic flow. Gervais et al. /13/ were studying acoustic wave generation by steady and unsteady heat release. The paper by Jonáš /27/ was useful for most of the experimentally working people discussing the production of homogeneous high turbulent flows using special grid systems. Scibilia's paper /23/ was an attempt to determine the law of the wall on rough surfaces by studying the behaviour of small particles in the near wall region of a boundary layer.

Though all participants appreciated that there was sufficient time for presentation and ample time for discussions following each paper, it seems that a reasonable time for a meeting of this kind should not exceed 3 days.

On the other side sufficient time and even some social events help to create a friendly atmosphere enhancing a lot of informal discussions and contacts and contributing thus to the main goal of the EUROMECH Colloquium to bring together people with the same scientific interests and problems.

R. Turvek

- /1/ G.E.A.Meier, E.Detemple-Laake, P. Doerffer:
3D Effects in Corner Flows
- /2/ S.M. Bogdonoff: Shock Wave Turbulent Boundary Layer
Interactions in Passages-Cross and Reflected Shock Wave
Phenomena
- /3/ P. Doerffer: Normal Shock \mathcal{A} -foot Topography at Turbulent
Boundary Layer
- /4/ V. Cyrus: The Three-dimensional Flow in an Axial Compressor
Stage at Design and Off-conditions
- /5/ Z. Mašek: Axial-Flow Turbine Nozzle Guide Vane Secondary
Losses
- /6/ R. Fuchs: Transonic Compressor Cascade Flow with Shock
Induced Boundary-Layer Separation
- /7/ J. Amecke: Stability of the Helical Inlet Flow of a Choked
Annular Cascade
- /8/ C. Sieverding: Transonic Turbine Blade Trailing Edge Flows
- /9/ Th. Schröder: Unsteady Boundary Layer Transition and
Separation Process in Multistage Low-Pressure Turbines
- /10/ W.C.Selerowicz, A.P.Szumowski, G.E.A.Meier: Self Excited
Compressible Flow in A Pipe-Collar Nozzle
- /11/ V. Vlček: Nonstationary Flow in a Channel with Time Varying
Cross-Section
- /12/ V. Tesař: Efficiency of Generating Longitudinal Aerodynamic
Force on a Thin Long Object Passing Axially Through a Nozzle
- /13/ Y. Gervais, J.H. Peube: Acoustic Waves Generation by Thermal
Processes
- /14/ G.H.Schnerr, Th. Breitling, H.A. Jantzen: Effects of Heat
Addition on Shocks and Boundary Layers
- /15/ M. Göing: Effects of Secondary Air Flow Injection of
Hypersonic Thrust Nozzle Performance
- /16/ F. Maršík: Thermodynamic Approach to the Transonic Fluid
Flow Stability
- /17/ A. Neish, F.T. Smith: Hypersonic Interactive Flow in
Expanding Channels
- /18/ W. Koschel, W. Rick, S. Bikker: Numerical Studies on Viscous
Effects in Turbine Blading
- /19/ M. Šťastný, P. Šafařík: Some Properties of Transonic Flow
in a 2D Turbine Cascade
- /20/ L.E. Eriksson: Numerical Simulation of a Supersonic Inlet
Flow at Critical Conditions

- /21/ P.A. Giess: Cooperation of Numerical and Physical Convergence Criteria to Reduce the Computing Time of 2D Flow Field Calculations for Transonic Turbine Cascades
- /22/ M. Höger, K. Broichhausen: An Efficient Calculation Method for Viscous Transonic Flow in Compressor Cascades
- /23/ M.F. Scibilia: Effect of Particles in a Boundary Layer
- /24/ J.M. Charbonnier, J.H. Garem, R. Leblanc: Transonic Injection Normal to a Transonic Flow
- /25/ R. Dvořák, P. Ulrych, F. Maršík, G.E.A. Meier. On a Shock Wave/ Boundary Layer Interaction Typical of Supersonic Inlets
- /26/ Th. Breitling, J. Zierep: Computation of Transonic Viscous Flow over Airfoils with Control by an Elastic Membrane and Comparison with Control by Passive Ventilation
- /27/ P. Jonáš: Artificial Production of Turbulence at High Subsonic Velocities
- /28/ Z. Peradzynski: Flows Around Developable 3D Profiles
- /29/ U. Pirumov: Investigations of Viscous Nonequilibrium Flows Through Laval Nozzles