

Table of Contents

Examples of Recent Flow Computations

E. Krause and M. Meinke.....1

1	Introduction.....	1
2	Method of Solution.....	2
2.1	Governing Equations.....	2
2.2	Temporal Discretization	3
2.3	Spatial Discretization	3
2.4	Parallelization	4
3	Applications	5
3.1	Simulation of the Flow Field around ELAC 1.....	5
3.2	Large-Eddy Simulation of a Turbulent Flows	6
3.3	Simulation of a Piston Engine Flow	11
3.4	Vortex Breakdown.....	12
4	Conclusion	13
	Acknowledgements	14
	References	14

The Decay of Three-dimensional Deviations from the Fully Developed State in Laminar Pipe Flow

K. Gersten and M. Klika.....17

1	Introduction.....	17
2	Basic Equations.....	18
3	Perturbation Solution.....	20
4	Results.....	21
5	Characteristic Parameters.....	27
	References	28

CFD for Turbomachinery Blading Analysis and Design

A. Wiedermann.....29

1	Introduction.....	29
2	Quasi-3D Viscous Flow Analysis.....	30
3	Fully 3D Viscous Flow Analysis	33
4	Transient Flow Analysis.....	36

5	Concluding Remarks.....	37
	References.....	38

Flow Simulation in an Aerodynamic Diffusor of a High Loaded Radial Compressor using Different Turbulence Models

<i>M. Heinrich and I. Teipel</i>	39
--	----

1	Abstract	39
2	Nomenclature	40
3	Introduction.....	41
4	Description of the Numerical Scheme.....	42
5	Turbulence Models.....	43
5.1	The Baldwin-Lomax Model	43
5.2	Modification of Goldberg and Chakravarthy.....	44
5.3	3D Approach of the Algebraic Models.....	46
5.4	k- ϵ Model.....	47
5.5	Boundary Conditions	48
6	Results.....	49
7	Conclusion	55
	References.....	55

Two Effects of Diaphragm Bulge on Shock Tubes

<i>H.G. Hornung and J.J. Quirk</i>	57
--	----

1	Introduction.....	57
2	The Computational Setup.....	58
3	Early Phase of the Flow	58
4	Further Evolution of the Flow	60
5	Effect of Temperature Ratio	61
6	Implications for Practical Applications of Shock Tubes.....	61
7	Conclusions.....	64
	References	66

Boundary Condition for Pipe Elements in One-Dimensional Numerical Scheme

<i>M. Endo and J. Iwamoto</i>	67
-------------------------------------	----

1	Introduction.....	67
2	Numerical Scheme.....	67
2.1	Junction	68
2.2	Nozzle	69
2.3	Elbow	70
3	Application.....	71
3.1	Experimental Considerations.....	71
3.2	Numerical Simulation	72

4	Results and Discussions.....	73
4.1	Junction and Nozzle	74
4.2	Elbow and Bend	75
5	Conclusions.....	76
6	Acknowledgement	76
	References	76

Shock Waves Around Bodies in Unsteady Flow Fields

Chr. Hartmann, S. Kasten and K.G. Roesner.....77

1	Introduction	77
2	Basic Equations.....	78
3	The Algorithm for the Eulerian Approach.....	79
4	Results of Eulerian Equations and Discussion.....	80
5	Comparison with Results from Compressible Navier-Stokes Equations.....	83
	References	85

A Numerical Investigation of Mixed Convection on a Horizontal Semi-Infinite Plate

V. Noshadi and W. Schneider87

1	Introduction	87
2	Computational Domain and Boundary Conditions	89
3	Numerical Solutions.....	91
3.1	Upper Branch.....	91
3.2	Lower Branch Without Flow Reversal	93
3.3	Lower Branch With Reversed Flow Region.....	94
4	Conclusions.....	95
	Acknowledgements	97
	References	97

Tube Bundle Vibrations due to Cross Flow Under the Influence of Turbulence

K. Popp and O. Romberg 99

1	Introduction.....	99
1.1	Fluidelastic Instability.....	100
1.2	Turbulent Buffeting	101
2	Experimental Apparatuses.....	102
3	The Influence of Turbulence.....	104
3.1	Influence of Disturbed Flow due to Tripwires.....	104
3.2	Influence of Increased Upstream Turbulence	108

4	Investigation of the Acting Fluid Forces.....	109
5	Conclusions.....	112
	Acknowledgement	112
	References.....	112

Whirl Distribution Measurements in Front of the Impeller of a Centrifugal Compressor

<i>I. Kassens and M. Rautenberg</i>	<i>115</i>
---	------------

1	Introduction.....	115
2	Test Compressor.....	115
3	Experimental Results	117
4	Concluding Remarks.....	119
	References	120

Velocity and Turbulence Measurements in the Flow Downstream of Flow Conditioners

<i>W. Merzkirch and K. Kalkühler.....</i>	<i>125</i>
---	------------

1	Introduction.....	125
2	Experiment.....	126
3	Results and Discussion.....	128
4	Summary and Conclusions.....	134
	Acknowledgement.....	135
	References	135

Experimental Research on Axially Excited Rotating Liquid-Liquid Systems

<i>J. Siekmann and D. Raake.....</i>	<i>137</i>
--------------------------------------	------------

1	Introduction.....	137
2	Experimental.....	138
3	Discussion of Selected Test Results	141
	Acknowledgement.....	145
	References	145

Routes into Chaos in Rotating Fluid Flows

<i>C. Egbers and H.J. Rath</i>	<i>147</i>
--------------------------------------	------------

1	Introduction.....	147
2	Theoretical Models of the Transition to Turbulence	149
3	Experimental Apparatus.....	150

3.1	Spherical Couette Flow Experiment.....	151
3.2	Taylor Couette Flow Experiment	152
3.3	Rotating Annulus Heated from within	153
4	Measuring Techniques	154
5	Methods of Time Series Analysis	156
6	Results.....	157
6.1	Route into Chaos in the Spherical Couette Flow	157
6.2	Route into Chaos in the Taylor Couette Flow	160
6.3	Time Series Analysis of Rossby Waves.....	163
7	Conclusion	166
	References	166

LIF-Diagnostics for the Investigation on the Chemical Structure of Diffusion Flames Burning Under Microgravity

J. König, Ch. Eigenbrod and H.J. Rath 169

1	Introduction	169
2	Setup and Specifications of the Laserdiagnostics (LDS) at the Drop Tower.....	170
3	Application of OH-LIPF to Microgravity Droplet Combustion.....	173
3.1	Single Wavelength Excitation.....	173
3.2	Multi Wavelength Excitation.....	174
3.2.1	Subtraction of Broadband Fluorescence	174
3.2.2	Transient Temperature Field Measurement by Means of two Wavelength OH-LIPF	175
4	Detection of Combustion Intermediate Species in Microgravity Combustion Experiments Using Raman-Shifted Excitation Wavelengths.....	177
4.1	LIF of Formaldehyde as Cool Flame Tracer.....	178
5	Conclusions.....	179
	Acknowledgement.....	179
	References	180