

# **21st International Shock Interaction Symposium 2014 (ISIS-21)**

Riga, Latvia  
3-8 August 2014

## **Editors:**

**I. Krassovskaya**

**A. Podlaskin**

ISBN: 978-1-5108-2295-5

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2014) The presented materials are subject to copyright by their respective authors.  
All rights reserved.

Printed by Curran Associates, Inc. (2016)

For permission requests, please contact the International Shock Wave Institute (ISWI)  
at the address below.

International Shock Wave Institute (ISWI)  
c/o: A. Podlaskin  
Ioffe Institute, Russian Academy of Sciences  
Politechnicheskaya 26  
St. Petersburg, 194021 Russia

Phone: +7(812) 297-4224  
Fax: +7(812) 297-1017

Sw2009@mail.ru

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: curran@proceedings.com  
Web: www.proceedings.com

# CONTENTS

## 1. Shock reflections and related phenomena

- G. Ben-Dor  
*Hysteresis phenomena in the reflection of shock waves* — 1
- O.Ram, M.Geva, O.Sadot, G. Ben-Dor  
*High spatial and temporal resolutions experimental shock-tube system for studying transient shock reflections* — 7
- M. Geva, O. Ram, O. Sadot, G. Ben-Dor  
*Examination of parameters influencing the non-stationary hysteresis reflection phenomenon* — 11
- R.T. Paton, M. Whalley, B.W. Skews  
*Mutual reflection of conical shock waves in a supersonic flow* — 16
- B.W. Skews, J.J. Bentley  
*Flows from two perpendicular shock tubes with a common exit edge.* — 21
- S. Kobayashi, T. Adachi  
*Experiment on the stability of oblique shock reflection in the dual-solution regime* — 26
- A. Sasoh, T. Tamba, N. M. Nguyen, K. Takeuchi, K. Nagata, Y. Sakai  
*Shock wave interaction experiments using double-driver shock tube* — 30
- M.G. Omang, J.K. Trulsen  
*Shock interactions with reacting and non-reacting particles* — 34
- M. Onofri, R. Paciorri, L. Campioli, A. Bonfiglioli  
*An unsteady Shock-fitting technique for unstructured grids* — 38
- E.I. Vasilev  
*Detailed investigation of Guderley shock wave reflections in steady flow* — 42
- E.A. Pushkar, A.S. Korolev  
*Impact of the interplanetary magnetic field on collision of solar wind and Earth's bow shocks* — 46
- E. Koroteeva, I. Znamenskaya, F. Glazyrin, N. Sysoev  
*Numerical and experimental study of shock waves emanating from an open-ended rectangular tube* — 52
- V.N. Uskov, P.S. Mostovykh  
*The flow gradients in the vicinity of triple points* — 57
- V.N. Uskov, P.S. Mostovykh  
*The gas flow in the vicinity of the center of a centered expansion wave* — 63
- S. Bobashev, B.Zhukov, R.Kurakin, S.Ponyaev, B.Reznikov, K.Tverdokhlebov  
*Specific features of shock-compressed gas flows in railgun channels* — 69
- L. Gvozdeva, S. Gavrenkov, A. Nesterov  
*Dependence of parameters across slip stream in triple shock wave configuration on adiabatic index* — 72

## 2. Vortices, boundary layers

- H. Oertel sen., J. Srulijes, R. Hruschka, F. Seiler  
*Mach waves of supersonic jets produced by shock/vortex interaction* — 76

A. Sakurai, M. Tsukamoto <i>Generation of wave from a wall surface by changing wall temperature</i>	— 82
J. Ryu, D. Livescu <i>Turbulent vortex dynamics across a normal shock wave</i>	— 85
L.A. Oliveira, L. R. Cancino, A. A. M. Oliveira. <i>Shock wave - boundary layer interaction: a CFD analysis of shock wave propagation in shock tube experiments</i>	— 91

### 3. Blasts and blast wave protection

D. Igra, O. Igra <i>Various options for achieving significant shock/blast wave mitigation</i>	— 97
S. Wiri, C. Needham <i>Reconstruction of IED Blast Loading to Personnel in the Open</i>	— 101
V. Eliasson, Q. Wan <i>Shock mitigation in ducts using obstacles placed along a logarithmic spiral</i>	— 106
S. Qiu, V. Eliasson <i>Numerical simulations of shock wave amplification using multiple munitions</i>	— 111
S. Berger, O. Sadot, G. Ben-Dor <i>Investigation of shock wave attenuation by dynamic barriers</i>	— 115
M. Liverts, O. Ram, O. Sadot, G. Ben-Dor <i>Mitigation of blast waves by aqueous foam barriers – implementation of the exploding wire technique</i>	— 120
A. Gerasimov, S. Pashkov <i>Modelling of shock and explosive destruction of constructional element: three-dimensional statement and probabilistic approach</i>	— 125
R. Tosello, H. Jobbé-Duval, D. Leriche, E. Léone, I. Sochet, L. Blanc, L. Biamino, C. Mariani, G. Jourdan, L. Houas <i>Numerical and experimental investigation of reflected and refracted blast waves</i>	— 129
R. Cayzac, E. Carette, T. Alziary de Roquefort <i>Gun muzzle blast waves: computations and experimental validations</i>	— 135
M. Silnikov, M. Chernyshov, A. Mikhaylin <i>Incident and reflected blast wave parameters at the diminished ambient pressure according to ICAO regulations</i>	— 141

### 4. Shocks in liquids

R. Patwardhan, V. Eliasson <i>Numerical simulations of shock wave propagation and fluid-structure coupling in water-filled convergent thin shells</i>	— 145
N. Apazidis <i>Numerical investigation of shock induced bubble collapse in water</i>	— 149
S. Sembian, M. Liverts, N. Tillmark, N. Apazidis <i>Shock Generation and Propagation in Water by Exploding Wire Technique</i>	— 152

Z.A. Walenta, A.M. Slowicka <i>Structure of shock waves in molecular liquids – influence of moments of inertia of molecules</i>	— 156
H. Yamamoto, K. Takayama, H. Shimokawa <i>Micro underwater shock waves generated by irradiations of Q-switched Ho:YAG laser beams</i>	— 159
N. Petrov, A. Schmidt <i>Effect of a bubble nucleation model on cavitating flow structure in rarefaction wave</i>	— 163
Y. Kai, B. Meyerer, W. Garen, U. Teubner <i>Experimental investigation of laser generated shock waves and the onset of evaporation in a mini-shock glass tube filled with water</i>	— 168
<b>5. Kinetics</b>	
H. Otsu, T. Abe <i>Thermochemical non-equilibrium phenomenon behind the strong bow shock for reentry vehicles</i>	— 171
S.N. Martyushov <i>Numerical simulation of reactive gas mixes flows in the detonation engine</i>	— 175
O. Kunova, E. Nagnibeda, I. Sharafutdinov <i>Vibrational-chemical coupling in air flows behind shock waves</i>	— 179
<b>6. Nozzles and jets</b>	
H. Yoshioka, H. Otsu <i>Hypersonic wind tunnel testing for investigation of the attitude of the ballute</i>	— 185
R. Buttay, P.J. Martinez Ferrer, G. Lehnasch, A. Mura <i>Simulations of highly underexpanded jets</i>	— 189
M. Silnikov, M. Chernyshov, V. Uskov <i>Overexpanded jet flow analysis in the vicinity of the nozzle lip</i>	— 195
<b>7. Complex media</b>	
T. Ukai, K. Ohtani, S. Obayashi <i>Experimental investigation of weak shock wave propagating through turbulent medium in controlled humidity field</i>	— 200
I. Basargin, S. Bobashev, M. Chistyakova, N. Monakhov, P. Popov, V. Sakharov <i>Peculiarity of interactions of shock wave with decaying plasma of gas discharge</i>	— 206
D.I. Zavershinskiy, N.E. Molevich <i>The formation of a magnetoacoustic self-sustained shock pulses in a thermally unstable medium</i>	— 209
N. Fomin, N. Bazylev, O. Penyazkov <i>Turbulence diagnostics with shocks by speckle tomography</i>	— 214
<b>8. Flows with bodies and obstacles</b>	
F. Gnani, H. Zare-Behtash, K. Kontis <i>Diffraction shock wave and supersonic co-flow interaction phenomena</i>	— 220

Y. Kikuchi, N. Onishi, K. Ohtani <i>Experimental demonstration of bow-shock instability and its numerical analysis</i>	— 226
O. A. Azarova <i>Supersonic flow control via combining energy sources</i>	— 230
F. Alzamora Previtali, E. Timofeev <i>On shock reflection from the straight wedges with circular concave tips</i>	— 236
E. Timofeev, A. Hakkaki-Fard <i>On unsteady shock reflections from convex circular surfaces</i>	— 237
D.V. Kotov, H.C. Yee, A. Hadjadj, A. Wray, B. Sjögren <i>High Order Numerical Methods and Subgrid-Scale Filtering in LES of Turbulent Flows with Shocks</i>	— 239
Z. Jiang, Z. Hu <i>Investigating into high-temperature flows behind strong shocks</i>	— 245
K. Takayama, T. Kikuchi, K. Ohtani, H. Yamamoto, A. Abe <i>Shock Standoff Distance over Blunt Bodies Projected at Supersonic Speed into Air, Water and Sand Layer</i>	— 246
Author index	— 259

## COPYRIGHT NOTICE

The presented materials are subject to copyright by their respective authors. Please restrict reproduction to your personal use.