

Symposium on Mechanics for Space Flight 1970-1980

By

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Symposium on Mechanics for Space Flight was held firstly in 1968 at Institute of Space and Aeronautical Science, University of Tokyo, sponsored by Japan Society for Aeronautical and Space Sciences. It was the time that the Apollo Program has been reaching its brilliant success and yet the fundamental scientific understanding related to space flight have not been flourished enough. Through this meeting, interdisciplinary cooperation among the fluiddynamicist, structural analysts, thermo-physicists and many other fields of science and technology has been organized based on their own scientific interests. Considering this success in scientific promotion, Institute of Space and Aeronautical Science, University of Tokyo took over this Symposium and later on sponsored this annual Symposium on Mechanics for Space Flight (SMSF). Here is the record of the discussions held at these symposium.

During the period of 1970 to 1980, eleven meetings in total have been organized, and at each occasion the preprints of the presented and discussed papers have been published. The following is the list of the titles of those papers appeared in the preprints. Naturally, all the presentation were made in Japanese, therefore the following list is only to communicate atmosphere of the Symposium, and is not authorized by the authors.

1st SMSF held on Jan. 27-28, 1970

- N. Nagatomo; A Plan of Testing Facility of Weightlessness
- K. Hida & H. Miura; Shapes of Droplet or Bubbles on a Wall under Microgravity Environment
- T. Nagaoka, K. Ito & T. Koreki; Combustion of Solid Propellant under high Acceleration Environment
- T. Hagiwara, T. Go & Y. Fujita; CAD for Spacecraft Design
- Y. Kobayashi; Optimization of Launching Time Based on Thermal Design of Spacecraft
- K. Oshima; Optimization of Spacecraft Thermal Design
- A. Nara & M. Ozaki; Optimization of Orbit Control
- K. Uesugi; Design of Yo-Yo Despinner
- K. Nitta; Consideration on System Determination Based on Guidance
- K. Kawata; Hypervelocity Fracture of Solid
- N. Satofuka; Numerical Analysis of Hypervelocity Impact Using Fluiddynamic Model
- G. Kamimoto, Y. Kimura & A. Tsukamoto; Ballistic Range of Kyoto University

2nd SMSF held on Nov. 26–27, 1970

- H. Shiomi; Space Environmental Testing of Electronics Components
A. Teranishi; Environmental Testing of Radiation
S. Endo; Space Environmental Testing-Mechanical Environment
S. Marumo, T. Owa, M. Saito & M. Kubo; Lubrication Testing Facility under Ultra High Vacuum
K. Kuratani; Residual Thrust and Its Mechanism
R. Akiba; Flame Impingements of Lambda and Mu Rockets
N. Nagatomo & A. Ushirokawa; Influence of Rocket Plume on the Output of Solar Cells
T. Hayashi & N. Hasebe; Electro-Magnetic Wave Interference due to Rocket Flight
K. Oshima; Rocket Plume at High Altitude
N. Kawashima; Optimization in Structural Design
K. Oshima; Prediction and Optimization for Spacecraft Design
Y. Yoshizawa; On 7th International Rarefied Gasdynamics Symposium
M. Takaki; Hypersonic, Rarefied Gas Flow past Two-dimensional, and Axisymmetric Body
M. Murakami & K. Oshima; Two-Dimensional Radiative Heat Transfer
K. Negishi; Characteristics of Radiative Heat Radiator
J. Suzuki & K. Kuriki; MPD Arc Jet
K. Tadera & M. Minegishi; Decay of Sloshing due to Multi-Baffle Plates
T. Sasaki, T. Ueta & H. Kimura; Fluidynamical Phenomena in Heat Pipes

3rd SMSF held on March 23–24, 1973

- S. Takeuchi; Motion of Artificial Satellite Without Atmospheric Drag
H. Takenouchi; Orbit Determination of Artificial Satellite
H. Maeda; Recent Progress in Space Flight Orbits
K. Uesugi; Optimized Orbit Transfer by Impulse
H. Inaba; Optimal Orbit Correction due to Impulse
T. Tanabe; Possibility of Optimal Guidance
M. Kusanagi; Coordinate Parameter for Skylab Simulator
S. Koizumi, K. Araki, G. Kondo, A. Isoya, N. Yoshitake, N. Kakuta & Y. Hanawa; Checkout Facility of ETS-ISS
K. Matsuo; Future Satellite Plan by Mu Rocket
M. Hinada; Analysis of Motion of Fragments of Rocket
H. Kimura & Y. Kuriyama; Theoretical Analysis of VCHP
K. Oshima; Thermal Analysis of Spacecraft Using Finite Element Method

4th SMSF held on Nov. 29–30, 1973

- S. Kubo; Stagnation Point Flow of Optically Thick, Radiation Gas
M. Murakami; Application of Case's Method to Radiation Gasdynamics

- H. Kimura; Thermal Control Research in USA
- S. Shimoji; Computational Method of Radiative Energy Input in Space
- F. Tamaki & M. Hinada; Rocket Aerodynamics
- K. Koura; Nonequilibrium Chemical Reaction Rate Calculated by Molecular Kinetics
- T. Soga; Analysis of Rarefied Gasdynamic Flow Using Discrete Ordinate Method
- Y. Sone; Rarefied Gas Flow Caused by Thermal Stress
- T. Matsushita & K. Oshima; Analysis of Evaporation and Condensation Problem Using Finite Element Method
- E. Onji; Surface Interaction Experiment due to Molecular Beam
- K. Oshima; Automobile Airbag
- Y. Yoshizawa & T. Marukawa; Critical Weber Number of Single Bubble
- T. Fujiwara; Flow Within a Droplet due to Shock Wave
- M. Hinada; Forced Opening Method of Parashute Using Vapor Pressure of Liquid
- J. Nishimura; Plastic Balloon
- A. Azuma & Y. Nakamura; Starting Characteristics of Recovery Rotor
- T. Tanabe; Recent Progress in Optimization in Guidance, Orbit Prediction and Orbit Design
- H. Ishitani; Guidance Method of M-3C
- K. Matsuo; Optimization of Low-Thrust Orbit
- F. Kikuchi; Discretization Error of Finite Element Method
- Y. Kuriyama; Finite Element Method in Fluid Dynamics

5th SMSF held on Oct. 3-4, 1974

- K. Nakagawa & M. Murakami; Radiative Heat Input to Satellite Born Antenna
- H. Kimura; Thermal Analysis of Antenna Using Finite Element Method
- S. Kubo; One-Dimensional, Unsteady Heat Transfer Through Radiative-Conductive Media
- K. Etori; Estimation of Shifts of Thermal Diffusivity by Heat Pulse Propagation in Solids
- I. Wada & Y. Inouye; Heat Transfer behind Flat Plate Back Step in Hypersonic Flow
- T. Ninomiya & N. Kawato; Three-Axis Attitude Control of Satellite
- I. Nakatani & M. Tanaka; Attitude Control Program and Simulation of Spinning Satellite
- K. Tsuchiya; Attitude Stabilization Analysis of Unsymmetric, Dual-Spin Satellite
- S. Imado; Attitude Control of Biased Momentum, Medium-Altitude Three-Axis Controlled Satellite
- H. Fujii; Attitude and Motion Analysis of Satellite with Movable Weight
- K. Matsuo & M. Honma; Pitch-Roll Resonance of Small Rocket
- M. Hinada & Y. Matokawa; Spinning Rocket with Movable Damper
- H. Oguchi; On the Rarefied Gas Dynamics Symposium
- Y. Sone; On 9th International Symposium on Rarefied Gas Dynamics Symposium

- K. Koura; Rarefied Gas Dynamics Accompanying with Chemical Reaction
T. Matsushita; Condensation Problem in 9 RGD Symposium
K. Masuda, T. Ikui & Murakami; Shock-Boundary Layer Formation on a Flat Plate in Hypersonic Flow
N. Satofuka; Discussions on Finite Difference Method in Compressible Flow Analysis
A. Sakurai & M. Iwasaki; Numerical Analysis of Flat Plate Leading Edge Flow by Navier-Stokes Equations
Y. Kuriyama; Flow Analysis in Heat Pipes Using Finite Element Method
N. Satofuka & F. Hitomi; Numerical Analysis of Viscous Flow in Shock Tubes
E. Akamatsu & S. Fujikawa; Formation and Break-Down of Single Bubble in Liquid Shock Tube
K. Oshima; Theory of Heat Pipes
T. Yamanishi; Application of Heat Pipes
Y. Kobayashi; Developments of Heat Pipes in USA

6th SMSF held on Dec. 10–11

- M. Fujiwara & K. Oshima; Thermal Testing of Spacecraft-Born Electronics
S. Kubo; Approximate Analysis in Radiation Gasdynamics
K. Etori; On the Solution of Unsteady Heat Conduction Equation
M. Hatakeyama; Numerical Analysis of Rarefied Gas Flow with Nonuniform Surface Reaction
Y. Sone & K. Aoki; Force Acting on Sphere in Weakly Rarefied Flow
T. Tsukamoto & M. Hinada; Numerical Analysis of Rotating Gas Sphere under Own Gravity
H. Nagasu; DAS Program
T. Yasaka; Thermal Vacuum Test of Satellite Antenna
K. Matsuo; Venus Flight Program
M. Ichikawa & H. Tomita; Deep Space Telemetry
M. Hinada; Deep Space Probe Configuration Design
T. Yasaka & Y. Kobayashi; Deep Space Probe Thermal Design
R. Akiba; Venus Probe
K. Matsuo; Reentry and Recovery Program
M. Hinada; Reentry and Recovery Vehicle Design
K. Tsuchiya; Resonance Trap of Dual-Spin Satellite
T. Matsuzaki & K. Oshima; Space Environmental Testing Using Mol-Sink
S. Endo; Large Space Chamber at Tsukuba Space Center
Y. Kobayashi; Progress on Space Environmental Testing
H. Saiki; Physiology of Weightlessness Under Simulated Space Environment

7th SMSF held on Nov. 8–9, 1976

- S. Takezawa & K. Ninomiya; Analysis of Attitude-Stabilizing, Active Magnetic

Damper

- K. Tsuchiya; Analysis of Attitude and Motion of Dual-Spin Satellite with Flexible Appendage
- T. Murakami & A. Nakajima; Attitude and Motion of Flexia-Symbal, Bias-Momentum Wheel Satellite
- M. Honma; Stability of Flight Vehicles with Extendable, Elastic Member
- T. Murakami & T. Kida; Possibility of Orbit Control due to Gravity Gradient Effect
- T. Murakami; Orbit Control due to Gravity Gradient Effect
- T. Fujiwara; An Report on NASA Ames Research Center
- K. Uesugi & H. Matsuo; Multi-Rendezvou by Low Thruster
- T. Shiho, K. Matsushima, M. Murata, H.Kurita, T. Yamamoto, N. Yamamoto, Y. Kosaka & T. Taku; On STANPS Program-Planetary Flight Simulation Program
- R. Akiba; BVS Program
- T. Yamanaka & Shibafuji; Space Material Processing Program in Japan
- M. Murakami; Technical Problems on Space Infra-Red Telescope
- S. Shimoji & Kimura; Thermal Problems for Spacecraft
- K. Etori; Statistical Analysis of Temperature Distribution and Heat Dissipation from Fin
- M. Hinada & S. Tsukamoto; Interference of Jet and Boundary
- K. Oshima; Space Contamination
- H. Oguchi; Recent Progress on Rarefied Gas Dynamics
- T. Ogawa & N. Oshima; Debris Flow under Completely Fluidized Condition
- N. Oshima; Unified Theory of Mechanics and Thermophysics for Mixture Fluid
- R. Takaki; Flow of Latex Dispersion System
- T. Murata; Permiable Flow into Porous Media
- Y. Yoshizawa; An Introduction of DFVLR-AVA
- T. Fukushima, T. Azuma & K. Kikuchi; Separation and Vortex Shedding in Unsteady Orifice Flow
- E. Niimi & Y. Kawano; Non-Linear Drag at Dividing Path
- M. Kawaguchi & A. Hamano; Two-Dimensional Pulsating Flow Past Threshold
- Y. Matsunobu; Unsteady Stangation Point Flow and Wall Effect
- M. Arakawa & Y. Matsunobu; Nonlinear Wave in Collapsible Tube
- K. Sato, T. Tanahashi, H. Tsuchida & T. Ando; Wave Phenomena in Straight Taper Tube
- M. Sugawara, I. Sato, K. Tamiya, N. Kitamura, T. Honda & Y. Sakurai; Water Hammer Wave Produced by Artificial Vane
- S. Hatta, E. Akamatsu, C. Kitamura & T. Shiroyama; Artificial Heart Pump and Pulsating Flow

8th SMSF held on Nov. 14–15, 1977

- T. Yamaguchi, M. Sugawara & Y. Sakurai; Blood Flow Measurements Using Hot-Film Anemometer

- T. Tsuji, K. Suma & M. Sugawara; Fluidynamical Consideration in Heart Operation
- S. Tomita, K. Tomita & S. Yoshida; Experimental Study of Pulsating Circular Tube Flow
- H. Masumoto & K. Oshima; Flow Analysis of Rotating Heat Pipe
- K. Oshima; Propagation of Combustion Sound
- T. Takemura & K. Oshima; Experimental Study of Unsteady Turbulent Combustion
- T. Narasaki, S. Hagiwara & S. Yoshihara; Flow Separation and Shock Wave Formation in Rocket Nozzle Flow due to External Disturbance and Thrust and Thrust Vector Control by Them
- T. Abe; Analysis of Surface Slip Flow
- Y. Sone & K. Aoki; Thermal Convection and Drag Force Acting on Evaporating Particle
- M. Murakami & H. Tahara; Heat Transfer Device at Liquid Helium Temperature
- K. Etori; Analysis of Temperature Distribution Under Superconductivity
- S. Tsukamoto; Fluidynamical Simulation of Direct Impact of Two Gas Spheres under Gravitational Equilibrium
- M. Iwasaki; Potential Theory of Oscillating Wing in Uniform Flow
- N. Satofuka & K. Azuma; Numerical Analysis of Flow Around Arbitrarily-Shaped Body Using Automatic Grid Generation
- K. Kuriyama & K. Oshima; Viscous Flow Analysis Past an Oscillating Airfoil
- K. Ono, M. Yoshikawa, A. Natsume & K. Oshima; Experiments on Oscillating Airfoil
- R. Akiba; Long Term Vision of Rocket
- H. Matsuo & Y. Matogawa; On the ABSOLUTE Program
- T. Murakami; Long Term Influence of Gravitation Damper of Gravity-Stabilized Satellite to Orbital Motion
- A. Nakashima & T. Murakami; Precision Attitude Control of Satellite Using Reaction Wheel
- K. Tsuchiya; Analysis of Resonance Trap

9th SMSF held on Nov. 20-21, 1978

- M. Masumoto; Unsteady Phenomena in Heat Pipe
- S. Shimoji, H. Kimura & Matsushita; Analysis of Gas-Loaded Heat Pipe
- K. Negishi, S. Inui & K. Kaneko; Counter Current Vapor Liquid Two-Phase Flow in Heat Pipe
- K. Inouye, Y. Kutsuna, H. Takeshi, Y. Takasu & H. Nishiwaki; Heat Transfer Characteristics in Heat Pipes
- A. Mitani & M. Sakamoto; Heat Recovery System for Civil Use
- K. Ito; Heat Pipe Application to Broadcasting Equipments
- M. Murakami; On 3rd International Heat Pipe Conference
- T. Matsushita, H. Itagaki, Y. Kobayashi, H. Kimura & Y. Sakurai; Heat Pipe of ETS III Satellite

- T. Koizumi & K. Matsumoto; Scale-Up of Heat Pipe Heat Exchanger
I. Honda & S. Takasu; Heat Pipes for Cooling of Metal Die
Y. Ieda, Y. Ito, T. Ohtake, S. Inouye & Y. Fujiie; Heat Pipe Application to Heat Removal After Nuclear Pile Accident
T. Ohtake, Y. Ito, Y. Ieda, Y. Fukuzawa, S. Inouye & Y. Fujiie; Influence of Vertical Magnetic Field on Heat Transfer Characteristics of Liquid Metal Heat Pipe
I. Honda; Sodium Heat Pipes
T. Yamamoto, M. Sasaki & H. Hattori; Characteristics of Test Sodium Heat Pipe
Y. Inatani, M. Hinada and S. Tsukamoto; Study of Nutation Damper
K. Etori; Thermal Wave Propagation in Liquid Helium II and Influence of Gravity
J. S. Chang, B. Evans, R. M. Hobson, K. Kamitsuma, S. Teii & K. Teshima; Spacecraft-Born Plasma Parameter Direct-Display System
K. Oshima; Recent Progress in Spacecraft Thermal Design
R. Akiba & F. Ren; Orbital Plan of Halley Probe
K. Uesugi K. Matsuo & M. Hinada; Spacecraft Design of Halley Probe
T. Hayashi, M. Ichikawa & H. Tomita; Communication System of Halley Probe
K. Matsuo; PLANET A Plan
Y. Matogawa; Optimization of Low Thruster Orbit with Causting
S. Tsuda; Goddard Problem of Skewed Launching
J. Nishimura; Capsule Recovery in Balloon Experiments
S. Tsukamoto, R. Akiba, J. Nishimura, M. Hinada, K. Matsuo, Y. Hashimoto & N. Hayashi; Decelerating Planning
H. Tomita, T. Hayashi, S. Imasawa, Ichikawa, K. Inouye & Maeda; Communication System Design of Recovery System

10th SMSF held on Nov. 15–16, 1979

- R. Akiba, T. Hayashi, K. Matsuo, K. Uesugi & M. Ichikawa; PLANET A Project
K. Matsuo; SOP Project
M. Hinada & S. Tsukamoto; Capsule Recovery System
K. Miura; Structural Concept of Large Space Structure-Membrane Concept
Y. Ohkami & T. Hanaha; Mode Analysis for Hybrid Display of Flexible Satellite Attitude Movement
J. Muto & K. Yamamoto; Behavior During Launching and Deploying Phase of Solar Cell Paddle
K. Matsuo & J. Kawaguchi; Attitude Control of EXOS-C
K. Shoda & K. Yoneta; Identification of Satellite Thermal Characteristics Using Singular Expansion
S. Shimoji; Temperature Data Analysis Method of Satellite
K. Etori; Gravity Effect on the Second Sound Wave Speed in Liquid Helium II
N. Oshima; Drag Rule of Fluid Containing Highly Packed Particles
H. Masumoto; Temperature Characteristics of Gas-Loaded Heat Pipe
M. Murakami, H. Tahara & N. Kaido; Experiments of Superfluid Heat Pipes
S. Tazoe; Heat Disposal by Heat Pipes of Closed Electronic Canister

- T. Yamamoto, M. Sasaki & K. Kaneko; Heat Pipe Developments for Medium to High Temperature
- K. Negishi & K. Kaneko; Counter Current Shear Flow in Heat Pipes
- H. Kimura & Y. Sakurai; Recent Progress in VCHP Developments
- T. Matsushita, H. Itagaki, Y. Nakamura, T. Ohgushi, Y. Sakurai & T. Tanaka; Maximum Heat Transfer Capability of Composit Wick Heat Pipes
- S. Kubo; Initial Value Problem of Radiation Heat Transfer
- T. Abe & K. Niu; Viscosity Decrease due to Electro-Magnetic Instability
- T. Okada & K. Niu; Electro-Magnetic Instability and its effect to Transfer Properties
- M. Yamashita, T. Sano & S. Kotake; Study of Elementary Condensation Process
- N. Takahashi, K. Teshima & I. Fusunoki; Velocity Analysis of Molecular Beams of NH₃, CO₂ Using TOF Method
- K. Miyake; Structure of Weak Shock Wave in Rarefied Gas
- T. Ohbayashi & H. Togo; Weakly Rarefied Flow Past Contacting Two Spheres
- K. Nambu & Y. Watanabe; Rarefied Gas Flow of Monoatomic Gas Through Two-Dimensional Nozzle
- S. Suzuki; Flow Measurement and Data Processing of Rarefied Flow

11th SMSF held on Nov. 20–21, 1980

- K. Uesugi; PLANET A Program
- J. Suzuki; MPD Plasma Engine
- K. Etori; Gravity Field Influence on Particle Density Diffusion on Sinusoidal Source
- H. Fujii; Earth Experiment of Attitude Control with Deployable Payload
- A. Nakajima; SPACE LAB Simulator in West Germany
- H. Masumoto; On AIAA Thermophysics Conference 1980
- Y. Sakurai; Life Test of Heat Pipes
- K. Negishi; Characteristics of Two-Phase Thermosyphon
- K. Kaneko & K. Negishi; Counter Current Shear Flow in Heat Pipes
- N. Ezawa; Solar Collector Heat Pipe for East-West Type
- M. Shiraishi & T. Yamanishi; Thermosyphon Heat Pipe Characteristics
- T. Yamamoto & Y. Tanaka; Sodium Heat Pipe Investigation
- K. Kiyoshi, I. Honda & S. Takasu; Heat Pipe Application of Heat Sealer of Automatic Machine
- T. Nakamoto, I. Honda & S. Takasu; Heat Pipe Developments for Heavy Oil Combuster
- M. Murakami; Heat Pipe Developments in USA
- Y. Oshima & K. Oshima; Separation and Vortex-Report of ICTAM 1980
- S. Inouye; Boundary Layer Separation on the Upstream Moving Wall
- A. Natsume; Flow Analysis Round a Corner Using Discrete Vortex Method
- T. Fujiwara; Numerical Analysis of Euler, Nvier-Stokes Equations
- H. Uchida; Finite Element Analysis of Two-Dimensional, Viscous Flow

- F. Higashino; Blast Wave Analysis by Hartree Method
H. Honma & I. I. Glass; Analysis of Weak Blast Wave Using Random Choice
K. Oshima; Report of 7 International Symposium on Numerical Methods in Fluid Dynamics
H. Mikami & T. Saito; CO₂/He Supersonic Free Jet upon Liquid Nitrogen Cooled Surface
T. Soga, M. Takanishi & M. Yasuhara; Low Density Flow Experiments by Electron Beam Fluorescence Method
K. Nambu; Direct Simulation Scheme Derived from the Boltzmann Equation
K. Nambu & Y. Watanabe; Relaxation Rates of Inverse-Power and Rigid-Sphere Molecules
K. Nambu; Slowing Down of Energetic Molecules in a Spatially Uniform Gas
H. Togo; Thermal Stress Slip Flow of Weakly Rarefied Gas Flow Around Separated Spheres
N. Takahashi, K. Teshima & I. Kusunoki; Velocity Analysis of Multi-Atomic Nozzle Molecular Beam by Flight Time Method
K. Koura; Monte-Carlo Simulation of Rarefied Gas Interference with Light
Y. Yoshizawa; Collision Integral of Higher Moments
H. Oguchi; Report of International Rarefied Gas Dynamics Symposium

In 1981, Institute of Space and Aeronautical Science, University of Tokyo was reorganized into The Institute of Space and Astronautical Science, which is expected to take full responsibility for the scientific space exploration program of Japan. The basic research activities are also expanding, and as a part of it Symposium on Mechanics for Space Flight is also promoted even more. The Proceedings of 1981 Symposium was published as *Uchukagaku-ken Hokoku* (in Japanese), and the Proceedings of 1982 Symposium is published as ISAS Report as this. In order to memorize these historical events, this note was written by the organizers.