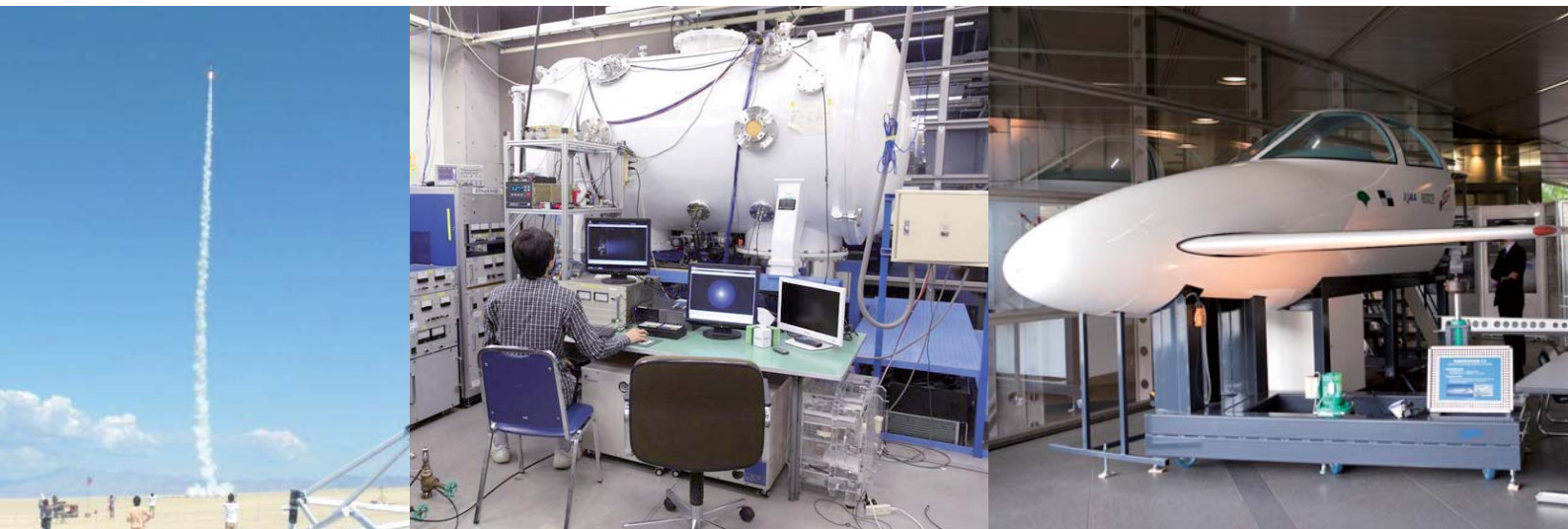


TOKYO METROPOLITAN UNIVERSITY

Faculty of Systems Design  
Graduate School of Systems Design

# Department of Aeronautics and Astronautics



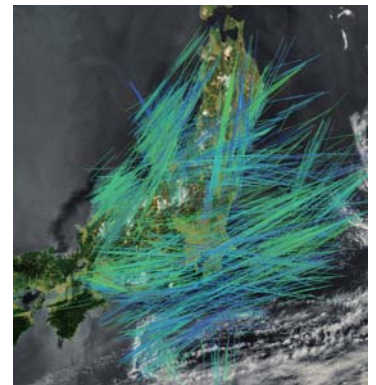
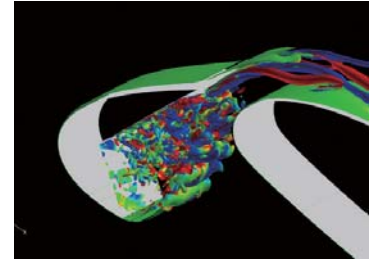
# Department of Aeronautics and Astronautics

## Introduction

Transportation by large, long-range aircraft, the flight of space shuttles, and the construction of the space station are some examples of recent developments in aerospace engineering. These developments highlight cutting-edge technologies such as light-weight high-strength materials, heat-resistant structures, miniaturization, high-performance propulsion systems, reductions in air drag, large-scale numerical simulations, and the construction of large structures in space. Aircraft for transportation, and artificial satellites for communication and weather forecast are now part of our daily lives. These aerospace technologies are key technologies that support our society.

Tokyo is a base in Asia for human and technological exchange among various cities Worldwide, and has important roles to play, both as an international airport and in the development of aerospace industries. In future, space-based information systems using satellites will be absolutely essential to help prevent disasters and to observe and monitor the environment.

In our Department of Aeronautics and Astronautics, students are encouraged to study the elemental and systematic technologies necessary for the development and utilization of aircraft and spacecraft. Students are expected to become engineers and researchers who can apply knowledge and who have broad vision, to enable the development of the next generation of scientific technologies, including those in the aerospace field.



## “What” and “How” do you study?

In undergraduate classes, students study the fundamental subjects of mathematics, physics, and chemistry. They later go on to study aerodynamics, propulsion engineering, structural and materialistic dynamics, and control engineering. Upon completion of these studies, students will understand the system engineering for designing aircraft and spacecraft. The program includes studies of space utilization, space information, communication, systems design and space utilization, and will be an educational program that will allow our students to play a role in a wide variety of fields.

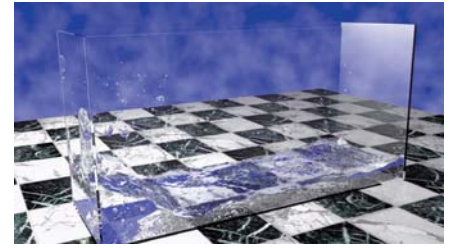
Laboratories and exercises using “hands on” devices are essential in the study of aerospace engineering. For this purpose, experimental facilities include a large, low-speed wind tunnel, a supersonic/transonic wind tunnel, a jet engine, a small rocket engine, a large vacuum chamber, a flight simulator, a weightlessness simulator, and a high-temperature fatigue simulator. From the undergraduate stage, students can gain practical experience with these types of equipment, which will serve to enhance their skills and senses as engineers and researchers. In this way, students can learn aerospace engineering through lectures, exercises, and laboratories.

In the fourth year, students are assigned to one of the laboratories. One faculty member will be responsible for a small group of about four students. In contrast to the studies of the first three years, students will have to study academic papers written in English, find core problems, select themes of study, find solutions by themselves, and present results to other people. This is an arena for logical thinking and discussion, and will help students to become global experts.



# Educational Program

The Department of Aeronautics and Astronautics at Tokyo Metropolitan University is an interdisciplinary one, with teaching and research in the following six research areas: Aerodynamics and Fluid Dynamics, Structures and Materials, Propulsion Systems, Guidance, Control and Dynamics, and Space Utilization Technology.



## Aerodynamics and Fluid Dynamics

The aerodynamics and fluid dynamics area includes studies on boundary-layer instability and transition to turbulence, flow control for reduction of aerodynamic drag and sound, high-speed aerothermodynamics and flow measurement techniques.

## Materials and Structures

The materials and structures area is categorized into subjects of development of new light metals and composite materials, mechanical property analysis of high-performance materials and the structural mechanics of satellites. Finite element analysis, numerical methods and experimental works are performed. Experimental work is also carried out at the Japan Aerospace Exploration Agency (JAXA).

## Propulsion Systems

The propulsion systems area includes researches on electric and chemical propulsion systems for satellites and spacecraft as well as gas turbines engines for aircraft and rocket engine systems for space launch vehicles.

## Guidance, Control and Dynamics

The guidance, control and dynamics area includes theoretical, numerical and experimental studies on dynamics and control of spacecraft and aircraft, with special attention given to electrodynamic tether systems, space elevator, autonomous free-flying space robots, control moment gyros, underactuated spacecraft, formation flying, air traffic management, air traffic analysis and trajectory optimization.

## Systems Design Engineering

The systems design area includes researches on design methodologies and their application for components and systems of aircraft and spacecraft.

## Space Utilization Technology

The space utilization technology area concerns research and development of advanced capabilities in remote sensing, satellite communications and key elemental technologies for space systems, to bring space closer to our lives.

### Professor

ASAI Masahito (Fluid Dynamics)

### Associate Professor

TAGAWA Toshio (Magneto-hydrodynamics, CFD)

### Assistant Professor

OZAWA Hiroshi (High-speed Aerothermodynamics)

### Professors

WATANABE Naoyuki (Structural Mechanics and Composite Materials)

KITAZONO Koichi (Aerospace Materials)

### Professor

TAKEGAHARA Haruki (Electric Propulsion)

### Associate Professors

INASAWA Ayumu (Aeroacoustics, Fluid Mechanics, Heat Transfer)

SAKURAI Takashi (Rocket Propulsion and Combustion)

### Assistant Professor

WATANABE Hiroki (Spacecraft Propulsion)

### Professor

KOJIMA Hirohisa (Guidance and Control)

### Associate Professor

TAKEICHI Noboru (Air Traffic Management, Space Systems)

### Assistant Professor

YOSHIMURA Yasuhiro (Spacecraft Dynamics and Control)

### Professor

SAHARA Hironori (Satellite System and Application)

### Associate Professor

KANAZAKI Masahiro (Computer Aided Design)

### Professor

USHIO Tomoo (Remote Sensing, Electromagnetic Wave Engineering)

### Assistant Professor

KAYABA Ayako (TORISAKA) (Structural Dynamics, Space Structure)

# Researchers

## Aerodynamics and Fluid Dynamics



Professor

**ASAI Masahito**

Ph.D. in Engineering

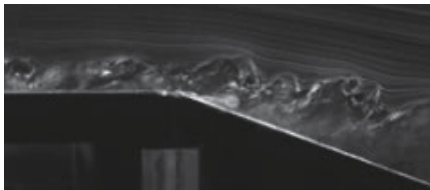
<http://aero-fluid.sd.tmu.ac.jp/>

### Lectures

- Fluid Dynamics, Aerodynamics

### Research activities

My research interests include flow instability, laminar-turbulent transition, wall turbulence, aeroacoustics and flow control.



Separation control of turbulent boundary layer

## Aerodynamics and Fluid Dynamics



Associate Professor

**TAGAWA Toshio**

Ph.D. in Engineering

<http://www.aerospace.sd.tmu.ac.jp/hydrodynamics/>

### Lectures

- Fluid Mechanics II
- Computational Fluid Dynamics I

### Research activities

We aim at elucidating various complex fluid phenomena including MHD, through the use of numerical simulations as well as experimental verification.



## Aerodynamics and Fluid Dynamics



Assistant Professor

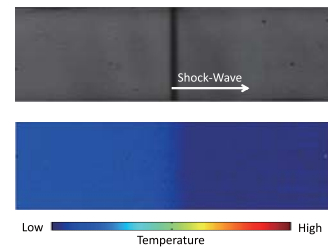
**OZAWA Hiroshi**

Ph.D. in Engineering

<http://aero-fluid.sd.tmu.ac.jp/>

### Research activities

Research and development of high-speed aerothermodynamics and optical measurement techniques.



Low Temperature High

## Propulsion Systems



Professor

**TAKEGAHARA Haruki**

Ph.D. in Engineering

<http://www.comp.sd.tmu.ac.jp/pp/>

### Lectures

- Thermodynamics II
- Aerospace Engineering: Experiment I
- Space Propulsion System
- Space Project Engineering
- Advanced Course of Space Propulsion System

### Research activities

Research into electric / chemical space propulsion systems using plasma engineering such as ion engines. Engineering applications in space technology, and system engineering of spacecraft.



## Propulsion Systems



Associate Professor

**INASAWA Ayumu**

Ph.D. in Engineering

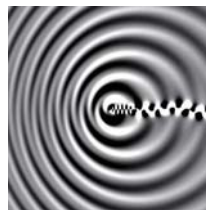
<http://aero-fluid.sd.tmu.ac.jp/people/members.html>

### Lectures

- Propulsion I
- Heat Transfer
- Advanced Aeroacoustics

### Research activities

Wind-tunnel experiments and computational studies in the areas of aeroacoustics, heat-transfer, and trans- and super-sonic aerodynamics.



## Propulsion Systems



Associate Professor

**SAKURAI Takashi**

Ph.D. in Engineering

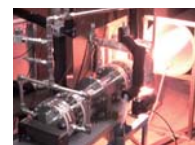
<http://www.sd.tmu.ac.jp/comb/index.htm>

### Lectures

- Thermodynamics I
- Combustion Phenomena
- Aerospace Engineering : Experiment I & II
- Combustion

### Research activities

- Hybrid rocket engines
- Combustion in micro gas turbines
- Meso-scale combustion and detonation



Swirling-flow hybrid rocket engine

## Propulsion Systems



Assistant Professor

**WATANABE Hiroki**

Ph.D. in Engineering

<http://www.comp.sd.tmu.ac.jp/pp/>

### Research activities

My research focuses on space electric propulsion. My current main subjects are the R&D of high power Hall thrusters and their electron sources, and the study of numerical techniques for the life assessment of ion and Hall thrusters.



Operation of radio frequency plasma cathode

## Materials and Structures



Professor

**WATANABE Naoyuki**

Ph.D. in Engineering

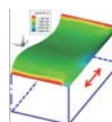
<http://www.aerospace.sd.tmu.ac.jp/wat/>

### Lectures

- Theory of Elasticity
- Mechanics of Aerospace Structures I & II
- Mechanics of Materials and Structures : Exercise
- Mechanics of Composite Materials and Structures

### Research activities

Our research field is categorized into the areas of composite materials, vibration analysis and structural mechanics, where finite element analysis, numerical methods and experimental works are performed. Experimental work is also carried out at the Japan Aerospace Exploration Agency (JAXA).



Dynamic analysis of fluid and rubber-like membrane interaction in large deformation (Deformation of membrane and stress distribution)

## Materials and Structures



Professor

**KITAZONO Koichi**

Ph.D. in Engineering

<http://www.aerospace.sd.tmu.ac.jp/materials/>

### Lectures

- Strength of Materials
- Aerospace Materials
- Microstructure of Materials

### Research activities

My research focuses on light metals and metal foams. Advanced energy absorbing materials have been developed through a collaborative research with JAXA.



Aluminum foam sandwich manufactured through superplastic diffusion bonding

## Guidance, Control and Dynamics



Professor

**KOJIMA Hirohisa**

Ph.D. in Engineering

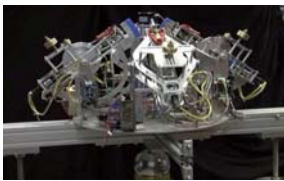
<http://www.comp.sd.tmu.ac.jp/spacelab/>

### Lectures

- Aerospace Control Engineering
- Space Vehicle Control Engineering

### Research activities

Main research interests include dynamics and control of spacecraft, such as electrodynamic tether systems, control-moment gyros, and space robotics.



Adaptive skew pyramid-array control moment gyro system

## Guidance, Control and Dynamics



Associate professor

**TAKEICHI Noboru**

Ph.D. in Engineering

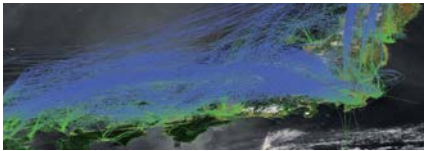
<http://www.comp.sd.tmu.ac.jp/navi/>

### Lectures

- Aircraft Flight Dynamics
- Fundamental Control Engineering

### Research activities

Our laboratory researches topics related to aerospace systems for civil engineering. Recent research topics are: -Air Traffic Management: 4D control, decentralized control, trajectory optimization and scheduling -Future Space Systems: Space Elevator, Near Earth Object Disposal.



Aircraft trajectories over Honshu

## Guidance, Control and Dynamics



Assistant Professor

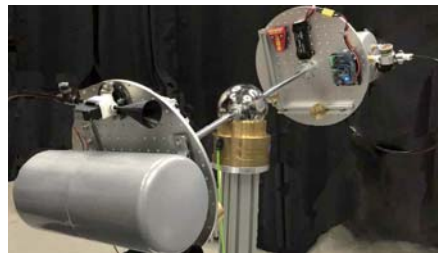
**YOSHIMURA Yasuhiro**

Ph.D. in Engineering

<http://www.comp.sd.tmu.ac.jp/spacelab/>

### Research activities

Research on underactuated spacecraft dynamics and control.



Attitude dynamics simulator

## Systems Design Engineering



Professor

**SAHARA Hironori**

Ph.D. in Engineering

<http://www.comp.sd.tmu.ac.jp/ssl/>

### Lectures

- Astrodynamics
- Spacecraft Systems Engineering : Exercise

### Research activities

We aim to create the future in space through the research and development of innovative space systems and their application in fields such as microsattelites.



Microsatellite, ORBIS

## Systems Design Engineering



Associate Professor

**KANAZAKI Masahiro**

Ph.D. in Information Science

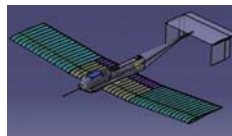
<http://www.comp.sd.tmu.ac.jp/aerodesign/>

### Lectures

- Aerospace Design Engineering
- Computational Fluid Dynamics II

### Research activities

The main theme is the design of aircraft and spacecraft using numerical techniques. Our design targets are trans-sonic/supersonic aircraft integrated engine nacelles, winged spacecraft, re-entry capsules and hybrid rockets.



Conceptual Design of High-Altitude Experimental Model for Martian Airplane

## Space Utilization Technology



Professor

**USHIO Tomoo**

Ph.D. in Engineering

### Lectures

- Aerospace Radio Engineering
- Aerospace Information System Engineering

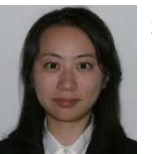
### Research activities

Research area in this laboratory involves microwave remote sensing, radio engineering, earth observation, and applied electromagnetics particularly focusing on development of the Polarimetric Phased Array Weather Radar System and algorithm development for the microwave remote sensing mission from space. Additionally, system design of the future satellite mission and aerospace navigation system are also investigated.



Phased Array Radar

## Space Utilization Technology



Assistant Professor

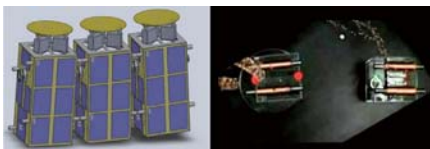
**KAYABA (TORISAKA) Ayako**

Ph.D. in Engineering

<http://www.comp.sd.tmu.ac.jp/rsl/>

### Research activities

Research on design methods and behavior analysis for building large flexible space structures.



Controlled docking by multi-dipole system

## Space Utilization Technology

Professor

**OBARA Shingo** (Cooperative Graduate School with JAXA)

Ph.D. in Engineering

<http://www.sd.tmu.ac.jp/~as.obara/>

Professor

**TSUJII Toshiaki** (Cooperative Graduate School with JAXA)

Ph.D. in Engineering

<http://www.aero.jaxa.jp/research/star/dreams/>

Professor

**ISHII Shoken** (Cooperative Graduate School with NICT)

Ph.D. in Science

<http://aero-fluid.sd.tmu.ac.jp/>

Professor

**KOGA Tadashi** (Cooperative Graduate School with ENRI)

Ph.D. in Engineering

<http://www.enri.go.jp/>



# Curriculum

The curriculum of this course covers the pillars of aerospace engineering: (1) subject groups that target aerodynamics, thermodynamics and engineering, (2) dynamics and control, as well as space utilization of aircraft and spacecraft, courses of interest, (3) materials and structural mechanics of aircraft and rocket in three subjects group of interest. This curriculum will foster student learning through the trinity of lectures, exercises and experiments.

## Basic & liberal arts group

	Basic courses group	Cultural courses group	Introductory courses group
1st grade and 2nd grade	<ul style="list-style-type: none"> <li>■ Basic Seminar</li> <li>■ Language courses</li> <li>■ Information Education</li> <li>■ Career education courses</li> <li>■ Health and physical education courses</li> <li>■ Elementary courses in science and technology</li> </ul>	<ul style="list-style-type: none"> <li>■ City, Society, and Environment</li> <li>■ Culture, Arts, and History</li> <li>■ Life, Humans, and Health</li> <li>■ Science, Technology, and Industries</li> <li>■ Synthesis Seminar</li> </ul>	<ul style="list-style-type: none"> <li>■ Humanities field</li> <li>■ Social sciences field</li> <li>■ Natural sciences field</li> <li>■ Health sciences field</li> </ul>

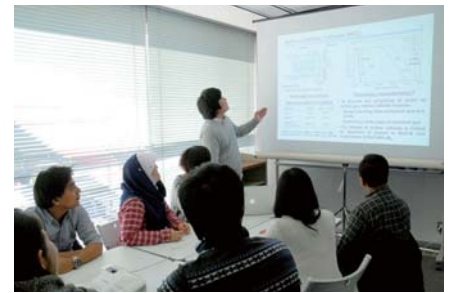
## Major education group

	Elective requirements			
	Elementary courses in Aerospace Engineering	Aerodynamics and Propulsion Systems	Dynamics and Control / Space Utilization Technology	Structures and Materials
1st grade	<ul style="list-style-type: none"> <li>■ Introduction to Aerospace Engineering I, II</li> <li>■ Material Mechanics I</li> <li>■ Fundamentals of Electric Circuits</li> </ul>			
2nd grade	<ul style="list-style-type: none"> <li>■ Fluid Mechanics I</li> <li>■ Thermodynamics I, II</li> <li>■ Basics of Vibration Engineering</li> <li>■ Mechanical Dynamics</li> <li>■ Material Mechanics II</li> <li>■ Applied Mathematics and Dynamics : Exercise</li> <li>■ Basics of Programming : Exercise</li> <li>■ Electronic Circuits</li> <li>■ Aerospace Engineering: Experiment I</li> </ul>	<ul style="list-style-type: none"> <li>■ Fluid Mechanics II</li> </ul>	<ul style="list-style-type: none"> <li>■ Fundamental Control Engineering</li> </ul>	<ul style="list-style-type: none"> <li>■ Strength of Materials</li> <li>■ Aerospace Materials</li> </ul>
3rd grade	<ul style="list-style-type: none"> <li>■ Aerospace Engineering : Experiment II</li> <li>■ Numerical Analysis : Exercise</li> <li>■ Design and Drawing</li> </ul>	<ul style="list-style-type: none"> <li>■ Aerodynamics I, II</li> <li>■ Computational Fluid Dynamics I, II</li> <li>■ Propulsion I, II</li> <li>■ Heat Transfer</li> <li>■ Exercise in Thermodynamics</li> <li>■ Combustion Phenomena</li> <li>■ Space Propulsion System</li> </ul>	<ul style="list-style-type: none"> <li>■ Aerospace Control Engineering</li> <li>■ Control Programming Practice</li> <li>■ Space Vehicle Control Engineering</li> <li>■ Satellite Communication Engineering</li> <li>■ Astrodynamics</li> <li>■ Aircraft Flight Dynamics</li> <li>■ Microwave Remote Sensing Engineering</li> </ul>	<ul style="list-style-type: none"> <li>■ Theory of Elasticity</li> <li>■ Microstructure of materials</li> <li>■ Mechanics of Aerospace Structures I</li> <li>■ Aircraft Vibrations</li> <li>■ Aerospace Design Engineering</li> </ul>
4th grade		<ul style="list-style-type: none"> <li>■ Computational Fluid Dynamics : Exercise</li> </ul>	<ul style="list-style-type: none"> <li>■ Space Project Engineering</li> <li>■ Spacecraft Systems Engineering : Exercise</li> </ul>	<ul style="list-style-type: none"> <li>■ Mechanics of Aerospace Structures II</li> <li>■ Mechanics of Materials and Structures : Exercise</li> </ul>

	Graduation work in Aerospace Engineering (required)	Courses offered by the faculty of System Design (elective)
3rd grade		<ul style="list-style-type: none"> <li>■ Special Lectures on System Design</li> <li>■ Internship</li> </ul>
4th grade	<ul style="list-style-type: none"> <li>■ Graduation Research in Aerospace Engineering I, II</li> </ul>	<ul style="list-style-type: none"> <li>■ Technical English in Science and Engineering I, II</li> <li>■ Laws and Regulations in Industries</li> </ul>

## Student life

Our faculty is located at Hino to the west of Tokyo, and is a peaceful residential area. There are many facilities in the local area, including public parks and a training gym. Students will be based at the Hino Campus of the Tokyo Metropolitan University. The campus is also the main campus for all third and fourth year undergraduate students at the university. Consequently, international students admitted to the university have many opportunities to meet and interact with local students.



## Admission

### Admission policy

TMU seeks students equipped with basic academic ability and the following qualities.

1. Intellectual curiosity
2. Distinctive personality, originality and creativity
3. Respect for personal relationships and the desire to contribute to society
4. Ambition and a willingness to make an extra effort

### Admission test for undergraduate students

Tokyo Metropolitan University has four faculties, three of which (except for the Faculty of Health Sciences) require applicants to take an entrance examination. Students will earn bachelor's degrees upon graduation once they complete the compulsory subjects and credits required by the schools, divisions, and programs.

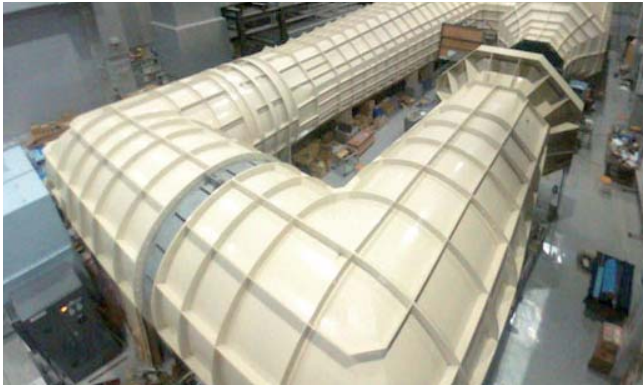
The admissions test and classes are provided in Japanese. Proficiency in the Japanese language is thus a critical prerequisite for enrollment.

### Admission test for graduate school students

Since each graduate school manages its own recruitment and screening, students wishing to enroll as graduate students are encouraged to visit the website of the school they are interested in for application guidelines.

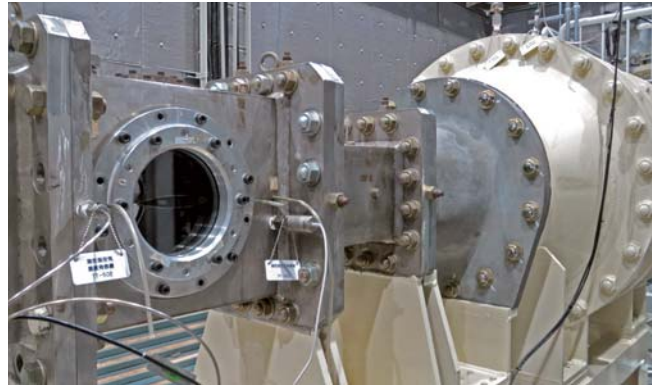


# Facilities



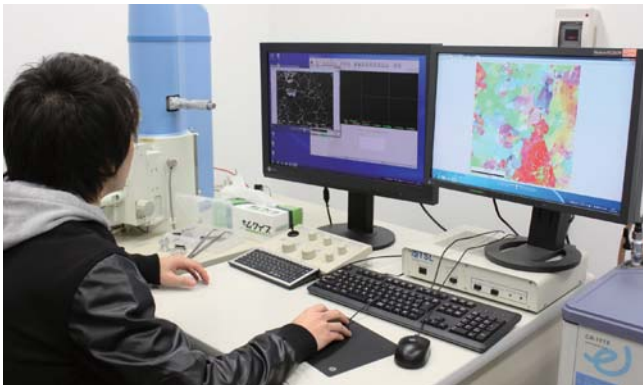
## Low-speed wind tunnel facility

The tunnel has an octagonal test section with diagonal distance of 1.75 meters. The maximum speed is 35 m/s (120km/h). Six-components balance and smoke generation facilities enable us to examine aerodynamics and flow around aerospace vehicles.



## Supersonic wind tunnel facility

Super-sonic wind tunnel facility "The tunnel has a rectangular test section whose cross section is 100 × 150mm. The maximum Mach number through the test section is 1.6. Flow around models can be visualized by Schlieren optics."



## Materials engineering laboratory

Microstructural observation of various materials using a scanning electron microscope



## Rocket engine and gas turbine test cell

Rocket engine and gas turbine can be operated. Experimental research on Hybrid rocket engines is conducted. A micro gas turbine is operated in the undergraduate course experiment.

# Hino Campus

Faculty of Systems Design (Junior and Senior Students)

6-6 Asahigaoka, Hino-shi, Tokyo, JAPAN 191-0065  
TEL. +81-42-585-8606

### Access

#### 1. From Narita Airport to Toyoda Station

Narita Airport Station → (JR Narita Express / 53 min.) → Tokyo Station → (JR Chuo Line / Rapid train / 48 min.) → Toyoda Station.

#### 2. From Haneda Airport to Toyoda Station

Haneda Airport Station → (Tokyo Monorail / 23 min.) → Hamamatsuchō Station → (JR Keihin-tōhoku Line / 6 min.) → Tokyo Station → (JR Chuo Line / Rapid train / 48 min.) → Toyoda Station.

