Department of Aeronautics and Astronautics, Faculty of Engineering, Kyushu University

Space Transportation Systems Engineering Laboratory

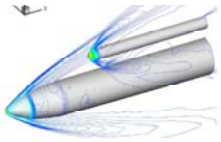
九州大学 大学院 工学研究院 航空宇宙工学部門 宇宙輸送システム工学研究室

The roles of Space Transportation Systems Engineering Laboratory are education and research on space transportation vehicles and systems. The research activities cover several major academic fields related on all the flight regimes. Especially, focal aspects are aerodynamics, high temperature gas dynamics and aerothermodynamics, future engine system, reentry dynamics and high-angle-of attack aerodynamics of reentry vehicles. Also we investigate ecological aircrafts for future commuter air transportation, to realize low noise , high efficiency and safety aircrafts.

High and low speed aerodynamic characteristics of RLVs

RLV (Reusable Launch Vehicle) is expected to become a future space transportation system. We investigate aerodynamic characteristics to improve flight performance, focusing on the **fuselage cross sectional shape** and **morphing concepts** and **active flow control** techniques. Wind tunnel tests and CFD analysis are applied from subsonic to supersonic flight conditions, and flight test using **RPV** (Remotely Piloted Vehicle) for the approach flight phase.

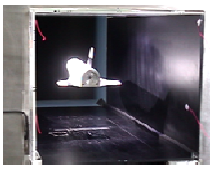

Wind tunnel test model


CFD analysis on TSTO


Wind tunnel test at M=4


Morphing device for enhancing fuselage vortex flow


RPV flight experiment

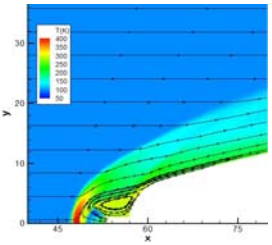

Magnetic suspension and balance system

Reduction of aerodynamic heating during reentry phase of RLVs


General view


Blunt test model in hypervelocity flow

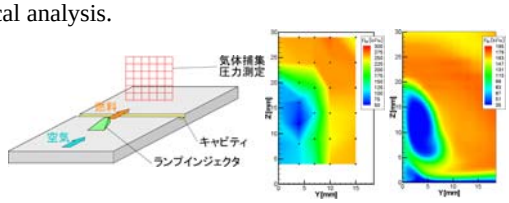
Free Piston Shock Tunnel


CFD analysis on opposing Jet (with extended nozzle)

We investigate the **thermal protection system** to reduce the aerodynamic heating of RLVs (Reusable launch vehicles) at reentry phase. The effect of the **opposing jet** and **film cooling** method is examined by means of supersonic wind tunnel test and CFD analysis. Also the experiment at the condition of high enthalpy flow is realized using a **Free-Piston Shock Tunnel** to simulate the flow phenomena during reentry. Also some new cooling devices have been proposed for reduction of aerodynamic heating and examined by experiments and numerical analysis.

Future aerospace propulsion system

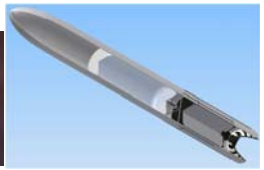
To realize hypersonic speed flight by **SCRAM-jet engines**, we propose highly efficient fuel injection and mixing methods for rapid mixing with air, analyzing the engine combustor flow field using supersonic wind tunnel test and CFD analysis. Also efficient **PDE (Pulse Detonation Engine)** propulsion systems with hydrogen and kerosene fuel have been investigated experimentally for the future propulsion system. Compared with liquid or solid propellant rocket engine, **hybrid rocket engine** has some advantages; especially easy to operate, safe and low cost. We propose and test a new oxidizer supply method to improve the efficiency and performance.



Injector Model and CFD analysis on SCRAM jet engine


PDE experiment

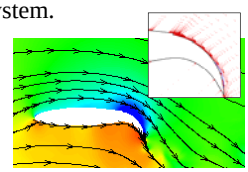

Hybrid rocket engine combustion test

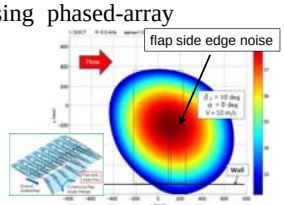

Hybrid rocket design

Ecological aircraft for future commuter air transportation

Conceptual design and research of **ecological small aircrafts** have been carried out to realize future air transportation system, as an on-demand flight operation **Air-Taxi**. To reduce fuel consumption, noise and emission gas, we propose new aerodynamic configurations, especially on Electric aircrafts. Also morphing wing/flap is developing as a low noise high lift device using phased-array microphones noise source detecting system.


Electric aircraft: wind tunnel and RPV flight test


CFD analysis on CCW-morphing wing



Noise survey by phased array microphones

Small satellites

QSAT-EOS(**Kyu**shu **Sat**ellite for **E**arth **O**bservation **S**ystem Demonstration) is a 50kg class satellite developing by universities and companies within Kyushu district. Preparation of ground station and construction of data analysis system for the operation after its launch have been progressing.

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