Precise and active control of heat transfer and fluid flow under extreme conditions is important for future science and technology. This laboratory has been conducting research on the fundamentals and applications of heat-transfer control under extreme conditions such as high temperatures of the order of thousands of degrees and microgravity environments. Energy transport phenomena and their control in complicated systems such as a global environment are investigated.

**LAPUTA Project (Upwelling deep seawater)**

We have proposed "the LAPUTA project" that has the potential of solving the global food problem without destroying land forests. A number of floating pipes are deployed with buoys in an ocean desert. The nutrients-rich deep seawater is upwelled by the perpetual salt fountain to the region where the sunlight reaches to cultivate phytoplankton. The drawn up deep seawater is heated during flowing up through the pipe and then remains on the surface. The increase in phytoplankton will enhance the food chain, and eventually fisheries and sea plant fields will be formed in the area.

![Concept of the LAPUTA project](image-url)
**Microscale Combustion**

Our research team tries to examine fundamental characteristics of microscale combustion with heat recirculation aiming to develop microscale power generators and microscale heating devices.

**Active Control and Measurements of Thermal and Solutal Diffusion Phenomena in Microgravity**

In-situ measurements of thermal and solutal diffusion phenomena are performed using microgravity environments obtained by rockets, airplanes and dropshafts. Diffusive phenomena and crystal growth can be observed under very small effects of natural convection.

**Heat-transfer Control of Thermoelectric Actuator and Its Medical Application**

The mechanism of rapid heat-transfer control of a thermoelectric actuator comprised of Peltier elements and a shape memory alloy is investigated. Active catheters and artificial hearts using the thermoelectric actuators are developed.

**Combined Heat Transfer in Complicated Systems**

We qualitatively investigate the factors affecting the global warming using numerical analysis of radiative transfer in the atmosphere.