

Performance Report 2019

Muroran Institute of Technology



Muroran City in 2060

2019.6
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1. MutoranIT Research Strategy 2060

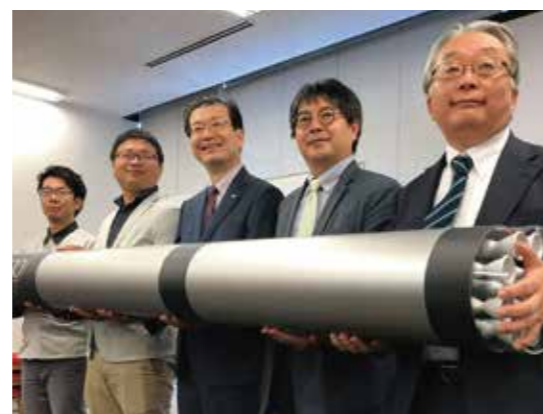
-From "Simple Manufacturing" to "Creating Value"

In-line with the mission of Mutoran Institute of Technology (MutoranIT) to contribute towards the development of Hokkaido, we have proposed a long-term research strategy "HOKKAIDO MONOZUKURI (MANUFACTURING) VISION 2060."

Given that a major wave of innovation in economic circulation and science and technology occurs every 40-50 years, the new platform describes the future of Hokkaido Province in 2060, when young researchers at MutoranIT will be able to innovative and develop with the help of creative science and technology.

Based on SDGs(Sustainable Development Goals) and the Japanese government-established "Hokkaido Comprehensive Development Plan," MutoranIT has created a draft titled "Engineer-Designed Vision 2060." The proposed draft involves a distinct perspective from future predictions by think tanks. It was thoroughly discussed at the Eminent Persons Group, which consisted of experts from industry, government, and academia and was chaired by Prof. NORIHITO Tambo, the Former President of Hokkaido University.

In the not-too-distant future, when the use of energy such as oil resources are on the brink of exhaustion, there will be a paradigm shift from expansion to the restriction period; "information" turning into energy liberates us from the constraint. Under such a magnificent and dreamlike concept, the vision clearly addresses how MutoranIT contributes to transforming Hokkaido into an area of a world-class value creation.



Next Generation Project: Launch of Joint Research with Interstellar Technologies Inc.



2. MutoranIT's Research and Education Capabilities highly acclaimed worldwide

RESEARCH Rise in THE World University Rankings 2020

MutoranIT has been included in the World University Rankings 2020 announced by Times Higher Education (THE), for two consecutive year. Last year, it climbed from 1001+ to 801-1000.

Among approximately 23,000 higher education institutions worldwide, our university ranks among the top 4% and at the 26th position in Japan (13th among national universities).



RESEARCH Top University in h-index in computer science

The "University Ranking" published by Asahi Shimbun reveals that MutoranIT ranked first in terms of the number of citations per article, in the field of computer science in the 2019 and 2020 editions, i.e., for two consecutive years.

h-index in the area of computer science (Asahi shinbun[University Rankings 2020])

Rank	University name	h-index
1	Mutoran institute of Technology	216.8
2	Iwate Prefectural University	157.6
	⋮	
10	The University of Tokyo	117.5
11	Tokyo Institute of Technology	116.8
12	University of Tsukuba	114.7

EDUCATION 3rd place in Hokkaido in education outcomes in THE Japan University Rankings 2019

THE Japan University Rankings of 2019 provides a comprehensive evaluation of the education capability at Japanese universities, based on internal and external data and a reputation survey for each institute. MutoranIT had a high evaluation score for the indicators of education resources and internationality as well as education outcomes, indicated by the performance of graduates.

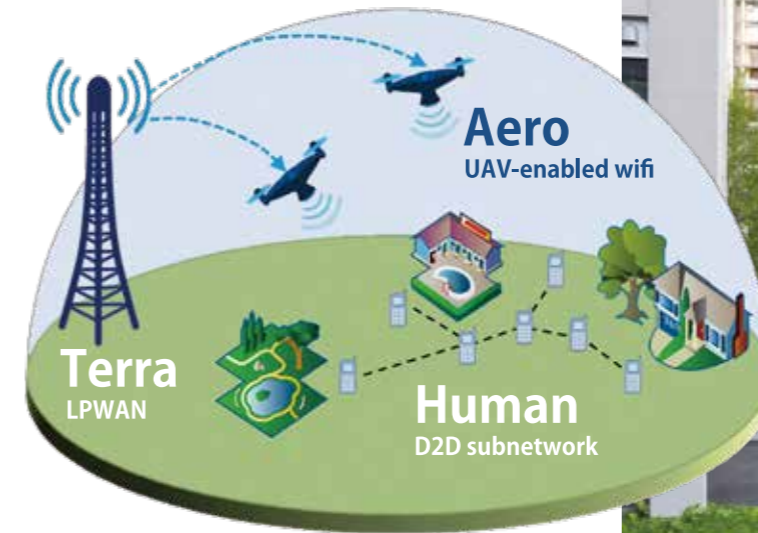


Aero, Terra, Human:

A Trinitarian Information Service System for Disaster Response

Drones are well-known in our daily life and are commonly used for capturing photos and videos as well monitoring from the sky. It is expected that drones will be applied for additional fields and purposes such as aquiculture, healthcare, supply-chain, education, and entertainment. Our research team has employed drones to develop a novel information service system for disaster response. Information services play an essential role in digital/virtual asset protection; they are also employed to provide immediate assistance to save lives, improve health, and support the morale of the affected population when disasters strike. However, it is possible that basic communication services may be unavailable when extensive damage is caused to the network infrastructure. In such cases, the delivery of information services is blocked. To solve this problem, we have designed a trinitarian information service system known as "Aero, Terra, Human" to enhance system resilience and resource efficiency when responding to disasters. The system consists of three main layers: (1) Device to Device (D2D) networks to connect users that are in proximity to each other in disaster-struck areas,

(2) Drone networks to work as a bridge between D2D networks and Low Power Area Network (LPWAN), and (3) LPWAN to connect to drone networks and provide external access networks to D2D network users. We are currently focusing on layer (2), and one of the key technologies is an AI-based autonomous flight navigation system for drones; this system employs AI-based visual recognition technologies for applications in the field of data science. A navigation system analyzes and processes images captured by a drone camera in real-time, recognizes surrounding situations, and finally locates the target, while controlling and maintaining its flight path. We are studying algorithms to realize a drone that is capable of independently processing these sequential actions. However, it is significantly challenging to realize these intelligent processes in a resource-constrained environment arising from the limited battery and computing capability of drones. We are currently working towards the practical applications of the entire system for several years.



Schematic of Next Generation Disaster Response Network Aero-Terra-Human System

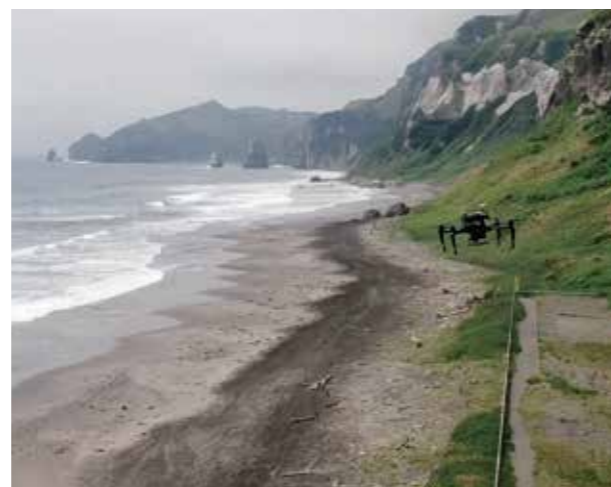


Using drones to convey messages to rescuers beyond disaster-struck areas

When people are automatically recognized by drone camera, flying near to them ending rescuers' messages from drone to outside of disaster area



Professor DONG Mianxiong



Using autonomous flying to locate people or cars in inaccessible places or places that are difficult to access

Associate Professor OHTA Kaoru



Visualizing current states of cities and traffic via big data and pursuing a richer and happier future for the City

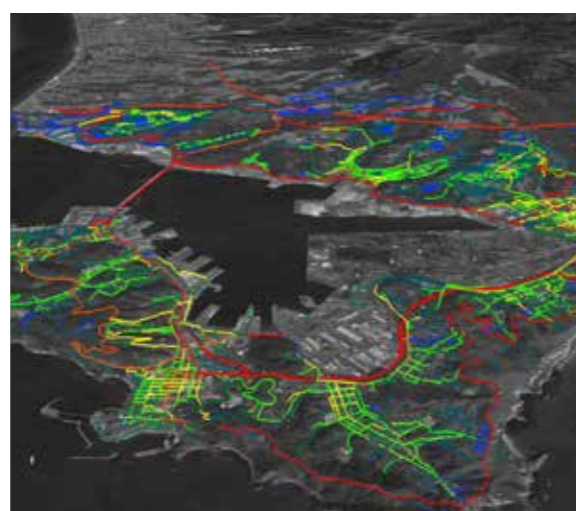
Our researchers are attempting to create sustainable cities and transportation systems by using a variety of statistical data. Conventionally, only analog methods such as a person trip survey have been used to understand the pattern of daily behavior pattern, using questionnaires. However, aside from this method, big data collected from devices such as smartphones, GPS, and ETC 2.0 have currently enabled us to analyze the movements of people and cars, with a high level of accuracy.

We seek optimization after scanning a city and understanding its current situation. Specifically, we address issues through various ideas such as the introduction of new transportation modes, including automated driving buses and the relocation of public facilities.

Currently, there is decline in the population of Hokkaido, which is 10 years ahead of the national average in Japan. This marks a great significance to propose new methods of urban development in this area. Shall we create a richer and happier city together?

Problem solving through a combination of various ideas such as introduction of new transportation system and relocation of public facilities

Image of 3D distribution of the population in Sapporo, based on mobile phone GPS data. Utilization for the development of strong anti-disaster cities



MAP:Google Earth



Associate Professor
ARIMURA Mikiharu

Elucidating the relationship between diet and dementia for dementia prevention

-Big data acquisition and analysis is expected to reveal the relationship between diet and dementia-



Visualization and quantification of the ability of foodstuffs to prevent dementia.

Development of cultivation systems to increase this ability of foodstuffs.



Construction and utilization of a food database.

Protein aggregation is involved in the pathogenesis of neurodegenerative disorders such as Alzheimer's disease. Approximately ten years ago, we reported real-time imaging of the protein aggregation using quantum dots. Thereafter, we developed a novel high-throughput screening system for aggregation inhibitors using this imaging method. Subsequently, we succeeded in automating the screening system by using robots and image analysis tools, and 128 heterogeneous samples could simultaneously be evaluated more rapidly and accurately. Thus far, we have evaluated more than 1000 types of natural products containing foodstuffs by using this system. We have found that many foodstuffs exhibit protein aggregation inhibitory activity, although their activities are widely distributed. In the future, we would like to evaluate almost all of the foodstuffs eaten by human beings and create a database of the activities in these foodstuffs. We believe that we can reveal the relationship between diet and dementia by analyzing the big data integrated with our data, nutritional data, cohort data on diet and dementia risk, etc. If the relationship between diet and dementia is clarified, each and every person will be able to prevent dementia while enjoying their favorite meals.



Associate Professor
TOKURAKU Kiyotaka