

What is the Doctor-Heli?

Rescue and emergency transport have been accomplished with helicopters for a long time, but the history of the “Doctor-Heli,” where doctors are flown to a site to provide early initial medical treatment, is comparatively short—only about 10 years since the service officially began in this country. Since laws aimed at the growth of the Doctor-Heli were adopted in 2007, a number of new helicopters continue to be introduced each year with 26 currently in operation throughout the country (fig. 1). The 7,167

dispatches in 2009 average to about 20 dispatches a day for the entire country. Still, compared to Germany, a leading country in helicopter emergency medical services, we have about 1/3 the number of helicopters in operation, despite an equivalent land area; therefore, this is expected to increase further in the future.

As a result of the introduction of the Doctor-Heli, the survival rate has increased and aftereffects have been mitigated. It is known that a patient in critical condition, such as cardiopulmonary arrest, has a 10% higher survival rate if early treatment is received one minute sooner.

The research and development of a flight management system for realizing efficient operation of the Doctor-Heli will be described in two parts.

Collaboration between D-NET and GEMITS

JAXA is continuing research and development of the “Disaster Relief

Aircraft Information Sharing Network” (D-NET) (fig. 2). This system will allow optimum flight management and information sharing through data transmissions between the disaster-response headquarters and the numerous aircraft concentrated around the disaster site when a large-scale disaster such as an earthquake occurs.

“Global Emergency Medical support Intelligence Transport System” (GEMITS) (fig. 3), currently under research and development with Gifu University playing a central role, is a system for information sharing through data transmissions between the ambulance and nearby hospitals to quickly select the optimum hospital for admission according to the patient’s condition. This is expected to resolve the social issue of hospitals “turning away” patients.

This research is focused on configuration of an effective emergency medical system that integrates emergency medical service helicopters and ambulances through the sharing of information between D-NET and GEMITS.

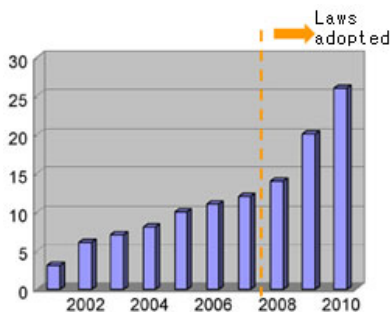


Fig.1: Shift in the number of the Doctor-Helis

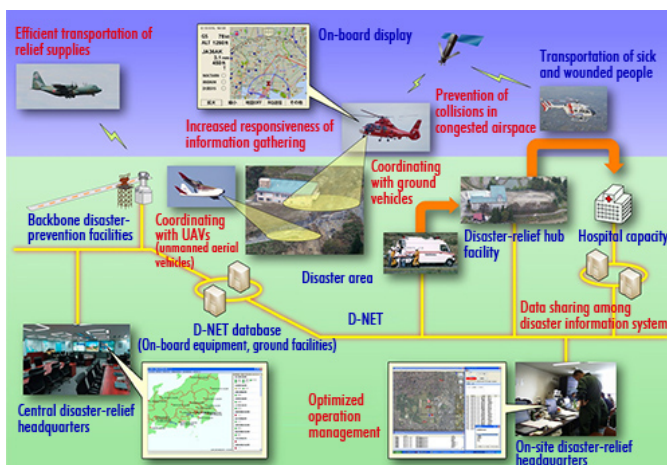


Fig.2: Basic concept of D-NET

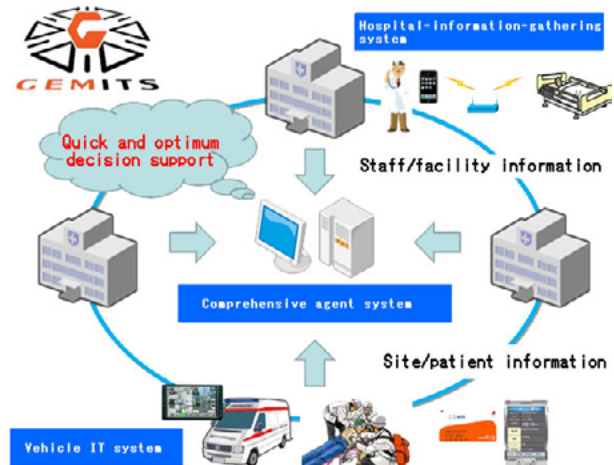


Fig.3: Basic concept of GEMITS

Members of the Disaster Prevention and Small Aircraft Operation Technology Section  
(From left) Keiji Kobayashi, Yoshinori Okuno



### Development of on-board equipment

On-board equipment for realizing flight management through data transmission has been developed and installed in Gifu prefecture's Doctor-Heli (fig. 4 and 5). The functions of the devices are described below.

1. Pilot display and
2. Medical display

These are the human interfaces for inputting/outputting various information. In order for the system to actually be useful at an emergency site where every second counts, we continue to evaluate and improve these devices while taking into account the opinions of pilots and flight doctors.

3. Vital signs monitors

The patient's in-flight electrocardiogram as well as blood pressure and arterial oxygen saturation measurements are sent to the admitting hospital.

4. Processor

This is the airborne computer. Compared to a computer normally used on the ground, this computer's environmental resistance to temperature/humidity fluctuations and vibrations has been strengthened; however, since it has a low processing performance, programming techniques are necessary for high-speed operation.

5. Satellite communication equipment

This communicates data by using Iridium satellites. The special feature of this equipment is that it can transmit through a compact antenna; however, since it has a low communication speed, solutions are needed to enable efficient transmission and reception of data.

6. Satellite communication antenna

This is installed at the top of the tail fin

in order to avoid being affected by the rotating main rotor blades.

Development of on-board equipment for the flight management system has been introduced in this volume. In the

next volume of this publication, we will introduce the new flight management flow utilizing these devices.

(Yoshinori Okuno)



Fig.4: Doctor-Heli introduced at Gifu prefecture

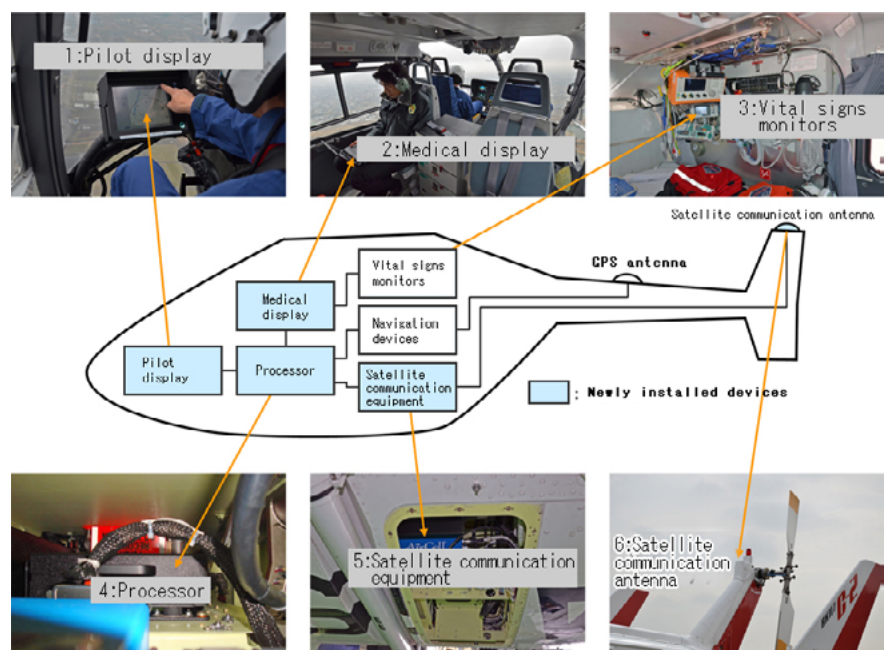


Fig.5: Installation of on-board equipment

# Development of technology for investigating noise sources on passenger aircraft

Civil Transport Team / Clean Engine Team

## Investigating noise sources on passenger aircraft

With the growing demand for passenger transport by air in the future, the frequency of passenger jet takeoffs and landings at airports is anticipated to increase. Besides the convenience of air travel, it will also lead to an increase in noise pollution around airports. Therefore, while considering that the lifespan of aircraft is about 20 to 30 years and that noise regulations will become increasingly stringent, newly developed aircraft must be quiet enough to provide a margin for projected noise regulations.

In order to develop quieter passenger aircraft, we must find their noise sources and gain an understanding of the noise generation mechanism. At the design phase of an aircraft, we can study possible noise sources through testing and analysis and predict the aircraft noise level as well as improve its design. However, the level and characteristics of actual aircraft noise can only be obtained during actual flight tests. Measurement technology called "noise source localization" is a powerful tool in accomplishing this investigation. Although JAXA has applied and improved the technique in wind tunnel tests and flight tests using small scale model airplanes, there has been no application of and experience with flight-testing actual aircraft in Japan. Therefore, since 2009, the Civil Transport Team and Clean Engine Team have cooperated to establish measurement technology using a business jet MU-300. In 2010, measurement equipment called a phased array was set up on a runway and noise source localization measurements were taken to verify the

current technology level and investigate areas of improvement.

## Phased array and various measurements necessary to identify noise sources

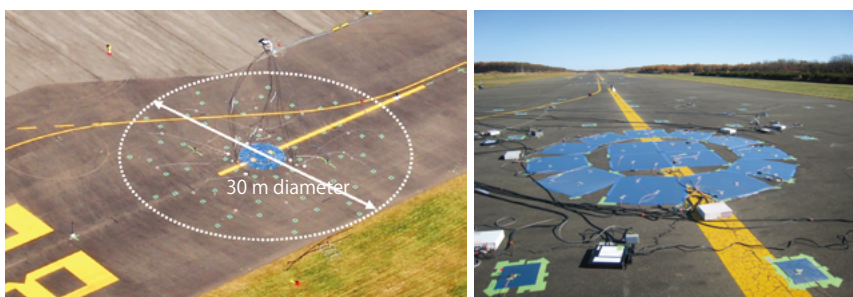
The phased array used to measure the noise sources was a device consisting of many microphones distributed over a wide area. By using the slight time lag (phase) for the sound wave emitted from the noise sources to arrive at each microphone, we could determine their level and location for every frequency. For this test, the phased array was designed to have a capability to resolve two 1 kHz noise sources separated by a 4 m distance on an aircraft flying at a 120 m altitude. It became an array consisting of 99 microphones arranged over a circular area with a 30 m diameter, as shown in figure 1.

The noise source localization measurements in flight tests must include the condition of the jet engine as well as the aircraft's position, attitude and speed while it is guided over the phased array in addition to acoustic measurements. Furthermore, weather

data, such as the distribution of wind direction and speed as well as the temperature and humidity, is also measured since the noise generated from the aircraft is attenuated and drifts while it propagates through the atmosphere before reaching the ground. These measurement operations were systematically conducted in the four groups shown in figure 2. A key feature of JAXA's system of noise source localization measurement is simultaneous measurement of the aircraft position and speed with the acoustics. It is accomplished with two line-scanning cameras placed with the phased array on the ground. The data are processed together shortly after the aircraft flies over the phased array, and visualized as noise source maps overlapping the aircraft image.

## Noise source measurement of a small jet aircraft

Flight tests were conducted from November 16 to 18, 2010 at the Taiki Aerospace Research Field. As shown in figure 3, while the business jet MU-300



(a) Aerial photo (Microphones are located at the green dots.)

(b) Ground setup

Fig.1: Phased array set up on the runway

Members who conducted tests  
 JAXA, Diamond Air Service, Inc., Mitsubishi Heavy  
 Industries, Ltd., Bruel & Kjaer, National Instruments  
 Corporation and AVEC, Inc

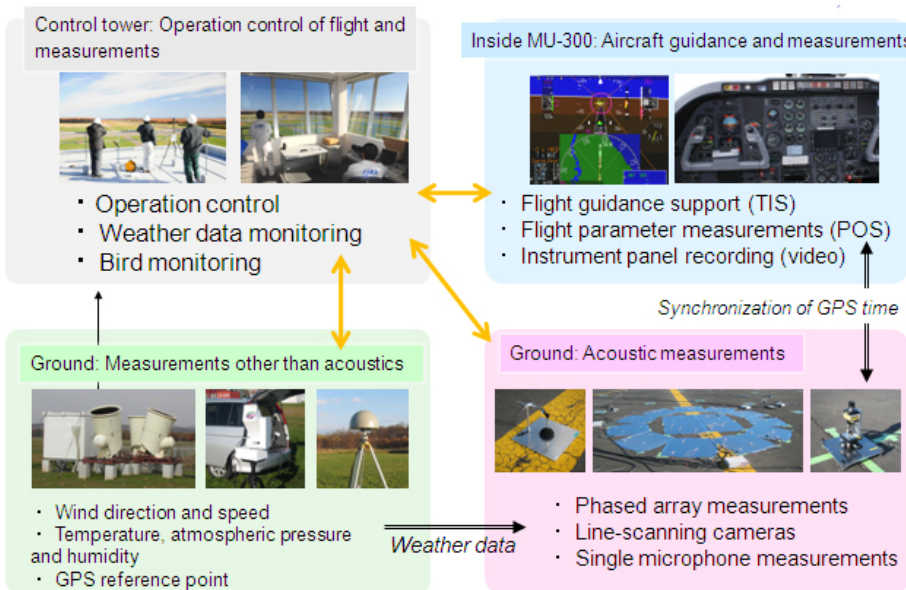


Fig.2: Overall organization of testing system and operations



Fig.3: Business jet MU-300 flying over the phased array on the runway

repeated approach, low-altitude level flight and climb to simulate takeoff and landing at various flight altitudes and speeds, the measurements were taken simultaneously on the ground and in the aircraft. Figure 4 shows typical results of visualized noise sources for 1000 Hz and 2000 Hz on the aircraft in a landing configuration deploying the landing gear and flaps at a level flight of 60 m altitude while keeping the engine thrust at the idle condition. At 1000 Hz, noise sources could be confirmed near the main landing gear and outside edge of the flaps as well as near the engine nozzle. At 2000 Hz, noise sources were observed near the engine nozzle, main landing gear and nose landing gear, but no longer at the outside edge of the flaps. In these tests, we could demonstrate the technology to localize multiple noise sources on a jet aircraft in flight. Now, we are continuing improvement

of technology for higher resolution to locate noise sources more accurately and for more detailed evaluation of noise source properties such as noise spectra.

These tests were conducted with support from Taiki town and Diamond Air Service, Inc. as well as with the cooperation of the Flight Research Center and the Operation and Safety

Technology Team at JAXA. We extend our deep appreciation to everyone involved.

(Kazuomi Yamamoto, Yuzuru Yokokawa)

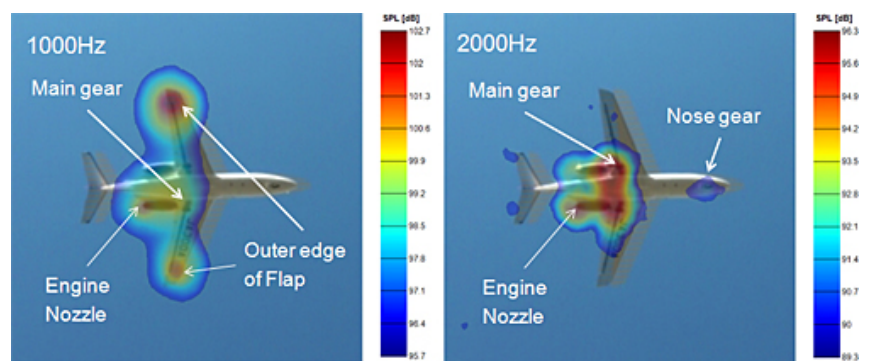


Fig.4: Sample results of noise source localization map (flaps down, landing gear down, engine idling, altitude 60 m, flight speed 60 m/s, level flight)

# Overseas Researcher's Report

## I have a dream...of "Hypersonic"

Since September 2010, I have been a visiting assistant research scholar in the Department of Aerospace Engineering at the University of Maryland in the United States. After I first arrived, I struggled to start a new life, but now my research is going well and I am leading a fulfilling life. Here, I would like to describe rather openly my life abroad.

### ■ Hypersonic research laboratory

I am staying as a visiting scholar at the Center for Hypersonics and Research within the Department of Aerospace Engineering at the University of Maryland, under the instruction of Professor Mark Lewis. Currently, I am researching intake (engine air inlet) configurations on the inward turning inlet concept. Generally, a supersonic/hypersonic intake uses shock waves to compress the flow; however, the advantage of the inward turning inlet is that, since most of the compression process is isentropic, the number of shock waves can be reduced, resulting in little loss and, thereby, reducing boundary layer bleeding. Until now, these intakes have been researched assuming use at hypersonic speeds in the high range of Mach 6 or more. However, my interest is to apply this intake concept to a hypersonic turbojet operating in the range from takeoff to Mach 5, which is being researched at JAXA.

The research laboratory is focusing on research concerning hypersonic aircraft and engine aerodynamics, and has covered a broad range of topics, including the issue of aerodynamic heating on re-entry, orbit optimization

of hypersonic aircraft, temperature-sensitive paint as well as schlieren imaging technology. This university is near Washington, DC and seems to feature a large government-affiliated research budget. However, most research is by numerical analysis, and full-scale tests are conducted at a hypersonic wind tunnel, called Tunnel 9, at the nearby Arnold Engineering Development Center (AEDC). The office is extensive with six doctoral students and one postdoctoral researcher, and what is interesting is that we are not performing activities like study groups (seminars), but have individual appointments and are consulting on research with professors. Furthermore, maybe it is because in the United States the activities of the individual are greatly valued, but there are some students who do not at all come into the research laboratory and only come to the university for meetings or only late at night. Nevertheless, they have a high motivation for their individual research activities, and can properly complete their theses without ever seeing each other.

Since the formation of the Air Force Research Laboratory (AFRL), Professor Lewis led hypersonic research there for some time. Although he is extremely busy this year as the AIAA president and the chair of the university's Department of Aerospace Engineering, he is available to meet former SR-71 pilots, make introductions toward visiting other research laboratories as well as give friendly advice. Recently, he has given recognition to the actor

Report by  
Takayuki Kojima  
Supersonic Transport  
Team



My office is in this building.



Research laboratory members



Animals living at the university

Harrison Ford (who seems to have often used his personal aircraft to provide life-saving assistance). Since there were many extremely witty stories in the university classes that I attended, I have tried to emulate that in my research presentations. Even the topic "I have a dream...of hypersonic flight", which alludes to the speech Reverend King gave in Washington, DC 40 years ago, received a "laugh". (By the way, the quotation marks are the V signs one makes with both hands to emphasize a word in a conversation.) I could provide many more anecdotes, but I will refrain from including them here.

#### ■ University of Maryland

Taking the Metro from Washington, DC, the University of Maryland is near the end, which would be just about to the suburbs of Kichijoji or Mitaka from Tokyo. Although it is about 20 minutes by car from the White House, one interesting fact is that the university has a farm, from which milk is taken to make ice cream that is sold, and we live in a relaxed environment. Prominent figures related to the aerospace field include Glenn Martin, founder of the Martin Company (now Lockheed Martin), as well as Frederick Billig, an inventor of the scramjet. As far as sports are concerned, basketball is popular, but the research laboratory students say "the coach and center are not very good", so it seems



University landscape in winter and spring

that they didn't have a good record this year.

#### ■ Daily life

I am living in an apartment that I am renting in Bethesda (also within Maryland). This city has a low crime rate, possibly because it is the location for the National Institutes of Health and nearly 10,000 medical researchers live here, and features many foreign nationals due to the fact that it is near an area where Washington, DC embassies are concentrated. Although the commute is a little long, I chose to live here for these reasons since the living environment was the priority. Taking the children to kindergarten every morning has become the daily routine. Because of the differences between Japanese and American culture, kindergarten was disconcerting in the beginning (we were surprised that children were dancing to the music of Lady Gaga), but now they enjoy going.

Many Japanese families live in our apartment building, and it is just like a pan-industry social event when the Japanese from Washington, DC and with various occupations, including those sent from government agencies (embassies, think tanks or universities) or from commercial firms, manufacturers or journalism get together. I am also living near those working at the JAXA Washington office. The Japanese community has developed the practice of helping each other, and we are maintaining a fulfilling life by increasing the number of Japanese friends. Last

month, as a fund-raising activity for the Tohoku earthquake, everyone folded cranes, put them in Easter eggs and distributed them at the kindergarten.

#### ■ American understanding of the earthquake

Currently, we can understand the condition of this unprecedented major disaster occurring in Japan since there is exhaustive coverage in the United States; however, we are frustrated that we don't know about, for example, the detailed living environment or mental state. People here are very worried, and some speak sympathetically while holding hands and with tears in their eyes. I was told how surprising it is that recovery was so quick that highways and trains were fixed in a few weeks and was consoled that, since this was a disaster caused by a natural phenomenon, nothing could be done about this unforeseen event occurring, as opposed to past nuclear disasters caused by human error. With this report, I hope to again transmit to the world the Japanese nature of "patient and orderly perseverance". Let's do our best.



Capitol Hill