

## ANALYSIS OF PASSENGERS' NEEDS AND DEMANDS OF ASTRAX ZERO GRAVITY SERVICES AND APPLICATION FOR SPACE TRAVEL SERVICES

Taichi Yamazaki <sup>a\*</sup>, Taiko Kawakami <sup>b</sup>

*a CEO and commercial astronaut, International Space Services, Inc. and ASTRAX, Inc., 2-23-17 Komachi, Kamakura, Kanagawa, Japan 248-0006,  
[taichi.yamazaki@astrax.space](mailto:taichi.yamazaki@astrax.space)*

*b General Manager, ASTRAX, Inc., 1-1-4-301 Mukogaoka, Bunkyo, Tokyo, Japan 113-0023,  
[taiko.kawakami@astrax.space](mailto:taiko.kawakami@astrax.space)*

\* Corresponding Author

### Abstract

ASTRAX's zero gravity flight services are offered in several countries around the world, including the United States, Russia, France, and Japan. ASTRAX, a Japanese private space services company, has been offering ASTRAX's original zero gravity flight service for general customers, not researchers, in Japan since 2012, using Diamond Air Services' small jets. So far, 21 flights have been conducted, and each client has fulfilled various dreams through zero gravity flights. By fulfilling various needs and requests in zero gravity flights, we will be able to fulfill new needs and requests in space travel. Based on these experiences and experiments, ASTRAX analyzes and predicts the needs and desires of space travelers (such as weddings, marriage proposals, model shoots, commercial shoots, drinking parties, fashion shows, musical instrument performances, and music concerts in the spacecraft), and develops various technologies and services to meet those needs.

This paper describes the results of the analysis of customer needs in zero gravity flights in Japan, the issues derived from the analysis, and the possibility of developing new needs and applying them to commercial spaceflight in the coming space travel era.

**Keywords:** ZeroG-Naut, Commercial Astronaut, Mission Commander, Space Flight Attendant, Space Travel, New definition of astronaut

### Nomenclature

Mission Commander: Commercial Astronaut to support passengers' mission in spaceship

ZeroG-Naut: support crew for passengers' mission in zero gravity flight

ASTRAX's zero gravity flight service in Japan has been using a small jet, the MU-300 made by Mitsubishi Heavy Industries, Ltd. Customers can fly with three passengers on board (total of 7 people (two pilots, one airplane company's flight attendant, one ASTRAX ZeroG-Naut, and three customers)).

There are only three customers per zero gravity flight experience, so each person can do a different simple experiment or challenge. For example, there were people who flew for weddings and proposals, played musical instruments, shot corporate PR footage, flew in costume, and even flew as a wizard on a broomstick. In order to meet these needs, along with advance preparation, coordination, and cooperation among customers, it is essential to have a ZeroG-Naut on board to support each mission. This support and direction increase the success rate of the customer's mission.

### 1. Introduction

This paper is an analysis of the needs of the passengers who participated in the zero gravity flight services by ASTRAX in Japan, as summarized in the paper presented at the International Astronautical Conference in 2020 (refer to the paper [17]), plus additional needs of the zero gravity flights conducted since then to date.

The paper is summarized as follows: Section 2: Overview of zero gravity flight services in Japan, Section 3: Common services provided by ASTRAX for each flight, Section 4: Analysis of various missions and passenger needs, Section 5: Issues, Section 6: New needs development in the space travel era, Section 7: Potential applications to commercial space flight, Section 8: Conclusion.

### 2. Overview of Zero Gravity Flight Service in Japan



**Fig. 1 ASTRAX Zero Gravity Flight Service**

### 3. The ASTRAX service for every flight

First of all, the services, preparatory work, and technology that ASTRAX provides to its customers for each of its zero gravity flight services include the following. (Table 1)

**Table 1. ASTRAX Service for Zero Gravity Flight**

Category	Contents
Preparation	Attracting customers, communications, logos, merchandise, letters, guidelines, customer information management, ordering, various arrangements, medical examinations, health care, document management, team building, etc.
Rehearsals by the Simulator	Perform a pre-check using the ASTRAX Zero Gravity Airplane Education and Training Simulator.
Pre-flight services	Hearings, transportation support, mental health checks, mental health support, etc.
In-flight services	Mental health support, filming support, experimental support, action support, real-time coordination and negotiations during the flight, etc.
Post-flight services	Transportation support, luxury parties, special certificates and award ceremonies, accommodation support, etc.

Confirmation of post-flight impact	Evaluation of impact after return to normal life
Post-flight services	Videos and photos sharing, videos editing, etc.

Section 4 describes the different missions of each individual passenger (or flight).

### 4. Various missions and passengers' requests that have been carried out

The common services (other than the zero gravity experience) that are performed throughout each flight include photo opportunities, Moon gravity and Martian gravity experiences (although whether or not Moon gravity or Mars gravity is performed depends on the customers' request and whether or not the customers are fatigued or has a time constraint on the flight time). The following are some of the various experiments and missions that have been performed in zero gravity by customers who have participated in the ASTRAX zero gravity flight service. (Table 2)

**Table 2. The Experiments and Missions in the ASTRAX Zero Gravity Flights**

Category	Contents
(1) Equipment, instrumentation, and functional tests (to determine if the aircraft can be used and performed in zero gravity)	
Blood Pressure Measurement	
Lotion application experiment	
Accessory (bracelet) behavior test	
Accessory (necklace) behavior test	
Small Medical Device Communication Experiment	
CASIO watch experiment	
CASIO Digital Camera Experiment	
SEIKO Watch Experiment	
Smartphone standard shooting experiment	
Smartphone levitation photography experiment	
New zero gravity flight suit demonstration	
Arm wrestling experiment	

Demonstration test of equipment 1 for taking group photos	The Wrinkle Experiment
Mixing experiment (two liquids)	Neck corset wearing experiment
Demonstration test of equipment 2 for taking group photos	The Wiggle-Off Experiment (Part 1)
New Space Flight Suit Demonstration Experiment	The Wiggle-Off Experiment (Part 2)
Soap bubble coloring experiment	Zero Gravity Scooter Flight Experiments (Part 1)
Propeller model airplane flight experiment	Hand-spinner flight test
Bamboo-copter flight experiments (Part 1)	Zero Gravity Scooter Flight Experiments (Part 2)
Fan flying experiments (three types)	Terminal Connection Experiment
Demonstration test of equipment 3 for taking group photos (Part 1)	Underwater drone flight experiments (report writing)
Demonstration test of equipment 3 for taking group photos (Part 2)	Underwater drone operability verification test
Model airplane flight experiment	Flower arrangement experiment
Flight Experiments of Bamboo Dragonfly (Part 1)	Cane experiment for the visually impaired
The Can of Candy Experiment	Egg cracking experiment
Space food docking experiment	Medaka swimming experiment
Water balloon + carbonated water + sponge experiment	Parrot flight experiment
Cocktail Glass Experiment	Hand spinner experiment (not conducted due to lack of time)
Verification of the importance of the pre-briefing	Fan flight experiment
Corset wearing experiment	Cracking a doughnut-shaped water balloon and observing its shape
Experiment in wearing an eye mask	Kusudama ball breaking experiment
Cash floatation test	Kururin Doggy Experiment (not done due to lack of time)
Smartphone levitation photography experiment (Part 2)	<b>(2) Action &amp; sports (Can it be done in zero gravity?)</b>
Illustrative Drawing Experiment	Rotational flight experiment
Boomerang test	Superman-like flight experiments
Water and oil mixing experiment	Water-drinking experiment
Water and foam mixing experiment	Space Curry Tasting Experiment
Blood Pressure Measurement experiment	Experiments in flight with the Wizard's Broomstick (Part 1)
Electrocardiogram Measurement Experiment	Zero gravity Human Tennis Experiment
	Flight experiment with balloons

Flight experiment with a handy fan	Cocktail Glass Experiment
Flying Carpet Experiment	Writing experiment in zero gravity
Experiments in flight with the Wizard's Broomstick (Part 2)	Skateboarding experiments
Experiments in flight with the Wizard's Broomstick (Part 3)	Swimming experiment
Ping-pong experiment (Part 1)	Flying wiggle experiment
Iron Array Experiment	Curry eating demonstration
Harry Potter's Broomstick Flight Experiment	Gravity of Mars to Gravity of the Moon to Zero gravity stepwise flight experiment
Experiment with drinking tea from a shampoo bottle	Forward somersault experiment
Ping-pong tournament	Water drinking experiment
Experiment to get out of a flight suit (scene from Lupin III)	Boxing experiment
Jump rope experiment	Shoe-shine experiment
MacBook (3 units) programming experiment	Zero Gravity Flight Experiment for the Visually Impaired
Ping-pong experiment (Part 2)	Assistive Technology Acquisition Experiment for the Visually Impaired
Normal levitation experiment	Crawl Swimming Experiment in Zero Gravity
Experiment of eating a rice bowl (onigiri) in a ceramic bowl	Eating Sweet Potato Chips Experiment
Paper Plane Boarding Experiment	Ballroom Dancing Experiment (Part 2)
Origami crane boarding experiment	Jumping in Lunar Gravity
Brave board flight experiment	Astral Sensation Verification Experiment (Part 1, Part 2)
Superman Flight Experiment	New Year's Calligraphy Experiment
Candy making experiment	Eating Ramen Noodles Experiment
Getting on an airplane made from plastic	Breaststroke Experiment
Space cleaning experiment with a handheld vacuum cleaner (video shoot for corporate PR)	Wine Drinking Experiment
Window cleaning experiment (video shoot for corporate PR)	Pouring ketchup on an omelet
Zero Gravity magic experiment	Making soft serve
Ballroom dancing experiment (Part1)	<b>(3) Cosplay levitation experiment</b>
Sash-turning experiment	AKB48
Backflip experiment	Angel
Hula-hoop diving experiment	Ornaments (hat, sunglasses)
	Witch's delivery service

Dragon Ball	Kimono (Yukata)
Harry Potter (Fig. 2)	New zero gravity flight suit (Gekidan Space Shokudo stage costume)
	Kimono
	Loincloth swimsuit
	Original flight suit
<b>(5) Instruments playing experiment</b>	
	Violin
	Guitar
	Helman Harp
	Recorder
	Blues Harp (harmonica)
<b>(6) Object PV shooting experiment</b>	
	Mineral water
	Books (Part 1)
	Leaflets
	Books (Part 2)
	Imitated Gold bar
	Bill
	Books (Part 3)
	Passport
	Candy (Part 1)
	Books (Part 4)
	Corset
	Underpants
	Towelket
	Organic millet rice
	Shumai bento (boxed meal)
	Sesamin
	Books (Part5)
	Candy (Part 2)
	Stuffed dog
<b>(4) Costume levitation experiment</b>	
Men's business suit	
New zero gravity flight suit	

<b>(7) Video shoot for corporate &amp; personal PR</b>			
Macbook Programming Experiment (IT Company)		3D camera photography experiments (Part 1)	
Space cleaning experiment with a vacuum cleaner (building maintenance company)		3D camera photography experiments (Part 2)	
Experiment with window cleaning in zero gravity (building maintenance company)		GoPro photography experiment (HERO 10, HERO 11)	
The world's first zero gravity magic shoot (magician)		LED Lighting Experiment	
Kimono and Fundoshi semi-nude shoot experiment (model)		OSMO POCKET photography experiment	
Aliven PR shoot (health promotion product company)		CANON wide-angle camera photography experiment	
Saida Dermatology PR shooting (for hospital PR)		Handy-cam photography experiment	
Space traveler PR shooting (for Space Working-Mom PR)		DJI gimbal camera photography experiment	
Photo shooting for PR of Mo-yan Curry (ukulele, singing and eating curry)		<b>(9) Various missions</b>	
PR photo of Tamura Construction (with uniform & flag)		World's First Zero Gravity Marriage Proposal	
Shooting for music video		Flight verification of artificial legs (Part 1)	
Doraemon the Movie PV Shooting		Record-breaking for the youngest (11 years old) person	
Filming of chilled yakiimo (sweet potato)		Family Ties Demonstration Experiment	
Filming of sweet potato chips		The youngest ever recorded (10 years old) person	
<b>(8) Experiments to verify photographic equipment</b>		Demonstration experiment against social withdrawal	
CASIO Digital Camera Experiment		2day series flights demonstrations (Part 1)	
Smart Phone Zero Gravity Normal Photography Experiment		Employee-to-employee flight verification (president and general manager)	
Smartphone Zero Gravity Levitation Experiment (Part 1)		Zero gravity flight in USA, Verification of Japanese customer service (transportation from Japan, accommodation, interpretation, etc.)	
Head-mounted camera experiments (Part 1)		Verification of handling large numbers of customers (different from small group flights in Japan)	
Head-mounted camera experiments (Part 2)		Verification of artificial legs (Part 2)	
360-degree camera shooting experiment		2day series flights demonstrations (Part 2)	
Single-lens reflex camera experiment (Nikon)		Husband and wife flight verification (Part 1)	
Smartphone Zero Gravity Levitation Experiment (Part 2)		Husband and wife flight verification (Part 2)	
		Employee-to-employee flight verification (president and employees)	
		Parent-child flight verification (mother and daughter)	

Family Flight Demonstration (father, mother and daughter)
Couple Flight Demonstration
Civilian Astronaut Training
Space travel training (Part 1)
Zero gravity flight attendant experience training (Part 1)
Zero gravity flight attendant experience training (Part 2)
Space travel training (Part 2)
Space travel training (Part 3)
Space travel Training (Part 4)
Space travel Training (Part 5)
Zero gravity flight attendant training
Space travel Training (Part 6)
Flight verification for the visually impaired

## 5. Issues

In the 21 zero gravity flight services over 11 years in Japan, the following challenges have been identified in meeting the needs of passengers.

- Cost of 1.5 million yen per person
- Small number of passengers, with only three people allowed on board
- Limited number of flight meetings
- Low number of parabolic flights
- Small market
- Limitations as an experimental aircraft
- Nationality of passengers (because the airfield where they take off and land is a military facility)
- etc.

## 6. Development of new needs in the space travel era

Private space travel will begin in 2021, and many space travelers have already flown in space. Some of the passengers who have made spaceflights have brought their own GoPro cameras, and Yusaku Maezawa, who has traveled to the International Space Station, has also conducted a great many experiments.

In the future, it is expected that even more diverse missions will take place, and we believe that the needs in zero gravity flight described in section 2 and the technology to meet those needs can be applied. To this

end, ASTRAX believes that it is necessary to develop new needs tailored to various spacecraft by making the following preparations.

- Preliminary validation (hardware and software) using interior simulators that simulate actual spacecraft.
- Training of zero gravity astronauts with skills suited to the mission.
- Training of mission commanders and spacecraft flight attendants.
- A sharing and analysis portal system.
- Various technical support services.

## 7. Possibility of application to commercial spaceflight

Among the various needs for zero gravity flight shown in Section 4, we have selected those that are likely to be in high demand in spaceflight as well.

These are not simply for the experience of zero gravity flight or spaceflight, but are needs that can be expected to be met by a wide range of customers, even if they are willing to pay a large sum of money for the service.

- Image training for travelers
- Wedding in space
- Proposal in space
- Funerals in space
- Concerts in space
- Commercial filming
- Filming a movie
- TV filming
- etc.

## 8. Conclusion

As the age of space travel begins, customers are going to demand all kinds of requests, as long as there are no safety issues. This is because you can almost do anything you want with money. For example, people might take their pets into space, or their kids might want to experiment with insects in space as homework for a science project. Unlike flying in an airplane, it's a completely different gravitational environment than on Earth, so it could be a tremendous evolutionary change for life on Earth.

In order to meet such a variety of unprecedented demands, it is not the pilot but the cabin crew (attendants) who fly with them as supporters of the customers that will be more important. (We believe that commercial spacecraft will be increasingly automated, and will be able to fly without a pilot.)

If a customer has flown in space many times, they may be able to do everything on their own, but it will take a while for that to happen. Until then, we will always need a mission commander and space flight attendant.

ASTRAX has dedicated training facilities, educational systems and tools to train people in all positions (photographers, chefs, singers, scientists, etc.) who can work in space. The accompanying mission commander and space flight attendant will be part of that system and service.

We don't anticipate these mission commanders and space flight attendants to ever go away because human activity will continue to expand in the future. This is because as the human activity area expands, there will always be a need for a support guide (or like a mountain-climbing guide or Sherpa). The more experienced they are, the higher level of service they can provide to their clients' needs and the higher the success rate.

As the era of space travel begins, the needs in space and the roles of support personnel to fulfill those needs will become increasingly fragmented. The roles and names defined here will probably change again, but first, here is a summary of the various needs for zero gravity flight by private passengers and the need for zero gravity astronauts and commercial astronauts at this time. We plan to revise this paper as we continue to monitor global trends. We hope that this paper will lead to the development of the private space travel industry in the future.

## References

### Reference to a conference/congress paper:

- [1] T. Yamazaki, 民間商業宇宙飛行士と新規宇宙ビジネスの展開について, 3D18, 50th Space Science and Technology Conference, Kita Kyushu, Japan, 2006, 8-10 November.
- [2] T. Yamazaki, OVERVIEW OF ASTRAX SPACE SERVICES INCLUDING OVER 50 SPACE BUSINESSES, ISDC-2018-Many Roads to Space, International Space Development Conference 2018, Los Angeles, USA, 2018, 24-27 May.
- [3] T. Yamazaki, ASTRAX ZERO GRAVITY FLIGHT SERVICES IN JAPAN, ISDC-2018- Many Roads to Space, International Space Development Conference 2018, Los Angeles, USA, 2018, 24-27 May.
- [4] T. Yamazaki, ASTRAX LUNAR CITY DEVELOPMENT PROJECT, ISDC-2019-Many Roads to Space, International Space Development Conference 2019, Washington D.C., USA, 2019, 5-9 June.
- [5] T. Yamazaki, ASTRAX SPACE SERVICES PLATFORM BY USING BLOCKCHAIN TECHNOLOGY, ISDC-2019-Many Roads to Space, International Space Development Conference 2019, Washington D.C., USA, 2019, 5-9 June.
- [6] Taichi Yamazaki, Buhe Heshige, Yoshihide Nagase, ASTRAX UNIVERSAL SERVICE PLATFORM BY USING BLOCKCHAIN TECHNOLOGY, IAC-19- E6.5-GST.1.6, 70th International Astronautical Congress (IAC), Washington D.C., United States, 2019, 21-25 October.
- [7] Taichi Yamazaki, MISSION CONTROL CENTER TO SUPPORT COMMERCIAL SPACE MISSIONS AND PASSENGER'S ACTIVITIES INSIDE OF THE CABIN, IAC-19-B3.2.3, 70th International Astronautical Congress (IAC), Washington D.C., United States, 2019, 21-25 October.
- [8] Taichi Yamazaki, ASTRAX ACADEMY AND SPACE BUSINESS AND SPACE FLIGHT SUPPORT EDUCATIONAL SYSTEM, Next-Generation Suborbital Researchers Conference (NSRC), Broomfield, CO, United States, 2020, 2-4 March.
- [9] Taichi Yamazaki, MISSION SUPPORT CONTROL CENTER AND SUBORBITAL SPACECRAFT SIMULATOR TO SUPPORT COMMERCIAL SPACE MISSIONS AND CUSTOMER ACTIVITIES, Next-Generation Suborbital Researchers Conference (NSRC), Broomfield, CO, United States, 2020, 2-4 March.
- [10] Taichi Yamazaki, ZEROG-NAUT AND MISSION COMMANDER TO SUPPORT COMMERCIAL SPACE MISSIONS AND CUSTOMER ACTIVITIES INSIDE CABIN, Next-Generation Suborbital Researchers Conference (NSRC), Broomfield, CO, United States, 2020, 2-4 March.
- [11] Taichi Yamazaki, "SPACE SCOOTER": SPACE MOBILITY SYSTEM USED IN SPACE HOTELS AND SPACE STATIONS, IAC-20-B3.7.17, 71<sup>st</sup> International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [12] Taichi Yamazaki, ASTRAX LUNAR CITY DEVELOPMENT PROJECT 2020, IAC-20-D4.2.11, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [13] Taichi Yamazaki, ASTRAX LUNAR CITY ECONOMIC SYSTEM BY USING BLOCKCHAIN TECHNOLOGY, IAC-20-E6.2.9, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [14] Taichi Yamazaki, ASTRAX SPACE SERVICE CATALOG SYSTEM FOR SPACE TOURISM, IAC- 20-B3.2.12, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.

- [15] Taichi Yamazaki, ASTRAX UNIVERSAL SERVICE PLATFORM BY USING BLOCKCHAIN TECHNOLOGY, IAC-20-D4.1.20, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [16] Taichi Yamazaki, EXPERIENCE AND LESSONS LEANED FROM THE COVID-19 PROBLEM IN JAPAN AND APPLICATION TO SPACE TRAVEL, IAC-20-A1.3.15, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [17] Taichi Yamazaki, ZERO-G-NAUT AND MISSION COMMANDER TO SUPPORT COMMERCIAL SPACE MISSION AND CUSTOMER ACTIVITIES INSIDE CABIN, IAC-20-B3.2.13, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [18] Chieko Takahashi, Yuko Kirihara, Creating a new business of Space Flight Attendant service & SFA Academy, IAC-20-B3.2.10, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [19] Taiko Kawakami, Taichi Yamazaki, THE IMPORTANCE OF KIMONO IN SPACE, IAC-20-E1.9.2, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [20] Taiko Kawakami, Taichi Yamazaki, WHAT WOMEN NEED FOR SPACE TRAVEL, IAC-20-E3.2.9, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 2020, 12-14 October.
- [21] Taichi Yamazaki, Taiko Kawakami, ASTRAX LUNAR CITY DEVELOPMENT PROJECT 2021, IAC-21-D3.1.6, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [22] Taichi Yamazaki, COMMERCIAL SPACE MISSION SUPPORT CONTROL CENTER AND SUBORBITAL SPACECRAFT SIMULATOR TO SUPPORT COMMERCIAL SPACE MISSIONS AND PASSENGERS ACTIVITIES IN SPACE, IAC-21-B6.2.12, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [23] Taichi Yamazaki, INITIATIVE OF DEVELOPMENT OF THE SOLAR SYSTEM ECONOMIC BLOC BY USING BLOCKCHAIN TECHNOLOGY, IAC-21-D4.1.11, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [24] Taichi Yamazaki, Mika Islam, SPACE FASHION AND SPACE CULTURE IN THE AGE OF SPACE TRAVEL AND THE POSSIBILITIES OF "SPACE HAGOROMO", IAC-21-E5.3.6, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [25] Taichi Yamazaki, Taiko Kawakami, Keiichi Iwasaki, Akifumi Mimura, MAKING ASTRAX ACADEMY ONLINE AND MULTILINGUAL, IAC-21-E1.7.10, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [26] Taichi Yamazaki, POTENTIAL FUTURE PLAN OF SPACE IZAKAYA AS A PLACE TO CREATE NEW PRIVATE SPACE BUSINESS, IAC-21-E1.9.10, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [27] Taichi Yamazaki, FOSTERING UNIVERSAL HUMAN RESOURCES AND SUPER NEWTYPES FOR THE SPACE AGE, IAC-21-E1.9.8, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [28] Taichi Yamazaki, Shunsuke Chiba, DEMAND AND SUPPLY MATCHING BY THE ASTRAX LUNAR CITY BUSINESS COMMUNITY AND RESIDENCE CLUB, IAC-21-D3.3.3, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [29] Taichi Yamazaki, OUTLINE OF ASTRAX PRIVATE SPACE BUSINESS CREATION EDUCATION AND TRAINING CENTER, IAC-21-B3.2.5, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [30] Taichi Yamazaki, PROTOTYPE PLANS FOR VARIOUS COMMERCIAL SPACECRAFT TRAINING SIMULATORS, IAC-21-B3.2.2, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [31] Taichi Yamazaki, Yuki Yamazaki, EXPERIMENTS ON COLORING SOAP BUBBLES UNDER MICROGRAVITY, IAC-21-A2.6.5, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [32] Taichi Yamazaki, STUDY OF THE SELECTION OF LOCATION FOR COMMERCIAL SPACEPORTS IN JAPAN, IAC-21-D6.3.8, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [33] Taichi Yamazaki, SPACE RADIATION SHIELDING BY WATER DOME IN ASTRAX

- LUNAR CITY ON THE MOON, IAC-21-A1.5.10, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [34] Taichi Yamazaki, Hiroki Nakaegawa, INTRODUCTION OF A PRACTICAL EXAMPLE OF ASTRAX LUNAR CITY MAPPING WITH MINECRAFT AND ITS LINKAGE TO ECONOMIC ACTIVITIES ON EARTH, IAC-21-D4.2.6, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [35] Taichi Yamazaki, Hiroki Nakaegawa, DEVELOPMENT OF A CIVILIAN SPACECRAFT INTERIOR SIMULATOR USING MINECRAFT, IAC-21-B6.3.11, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [36] Taichi Yamazaki, PROPOSAL TO ADD A SPACE ECONOMICS SUBCOMMITTEE TO THE UN OFFICE FOR OUTER SPACE AFFAIRS' COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE (COPUOS IN UNOOSA), IAC-21-E3.4.7, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [37] Ayako Kurono, Haruto Kurono, Taichi Yamazaki, THE GENDER GAP AND ITS IMPACT IN MANGA, ANIME AND OTHER SPACE CREATIONS, IAC-21-E5.3.10, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [38] Ayako Kurono, Haruto Kurono, Taichi Yamazaki, CAREER DESIGN IN SPACE - FROM CHALLENGED TO CHALLENGING, IAC-21-B3.9-GTS.2.1, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [39] Haruto Kurono, Ayako Kurono, Taichi Yamazaki, THE EFFECTS OF USING MINECRAFT TO TEACH CHILDREN ABOUT SPACE, IAC-21-E1.8.2, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [40] Tomoko Imaizumi, Taichi Yamazaki, MAINTAINING THE HEALTH OF PILOTS AND CREW, IAC-21-D6.3.4, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [41] Taichi Yamazaki, Mami Oka, CONSIDERATION ON THE CREATION OF A CHICKEN EGG MARKET AT THE MOON VILLAGE, IAC-21-D4.2.10, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [42] Chieko Takahashi, Yuko Kiriha, Taichi Yamazaki, CONSIDERATION OF THE FUTURE PROSPECTS OF THE SPACE FLIGHT ATTENDANT(SFA) PROFESSION WITH THE EXPANSION OF SPACE TRAVEL MARKETING, IAC-21-B3.9-GTS.2.10, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [43] Taiko Kawakami, Taichi Yamazaki, PROBLEMS AND SOLUTIONS THAT ARE PREVENTING MORE WOMEN FROM BECOMING SPACE TOURISTS, IAC-21-B3.2.3, 72nd International Astronautical Congress (IAC), Dubai, United Arab Emirates, 2021, 25-29 October.
- [44] Hayaki Tsuji, Taichi Yamazaki, Satoshi Takamura, Yoichi Sugiura, PEACE THOUGHT AND SOCIO-ECONOMY FOR THE SPACE AGE USING SATELLITES, IAC-20-E5.5.5, 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 2020, 12-14 October.
- [45] Taichi Yamazaki, ADVANCED SPACE SERVICE ACCESS APPLICATION TOOL: ASTRAX UNIVERSAL USER INTERFACE (U2U), IAC-20-B3.1.11, 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 2020, 12-14 October.
- [46] Taichi Yamazaki, Taiko Kawakami, DEVELOPMENT OF A TERIPPER FOR INTRA-SPACECRAFT TRANSPORTATION, IAC-22-A1.3.17, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [47] Taichi Yamazaki, Taiko Kawakami, POSSIBILITY OF ZERO-GRAVITY FLIGHT SERVICE BY MRJ (MITSUBISHI REGIONAL JET), IAC-22-A2.IPB.1, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [48] Taichi Yamazaki, Taiko Kawakami, DEVELOPMENT OF ASTRAX COMMERCIAL SPACECRAFT EDUCATION AND TRAINING SIMULATOR, IAC-22-B3.IPB.4, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [49] Taichi Yamazaki, Taiko Kawakami, DEVELOPMENT OF SPACE SHOWER, IAC-22-B3.3.5, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [50] Taichi Yamazaki, Taiko Kawakami, PRODUCTION OF SPACE SUITS AND REPLICAS FOR SPACE TRAVEL, IAC-

- 22-B3.9-GTS.2.1, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [51] Taichi Yamazaki, Taiko Kawakami, ADVANCED SPACE SERVICE ACCESS APPLICATION TOOL “ASTRAX UNIVERSAL USER INTERFACE (ASTRAX U2U)”, IAC-22-B5.IP.7, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [52] Taichi Yamazaki, Taiko Kawakami, ASTRAX SOLAR SYSTEM ECONOMIC BLOC CONCEPT USING NFT AND METAVERSE TECHNOLOGIES, IAC-22-D4.1.10, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [53] Taichi Yamazaki, Taiko Kawakami, DEVELOPMENT OF A REAL-LIFE (ANALOG) ASTRAX LUNAR CITY CONSTRUCTION PROJECT IN JAPAN, IAC-22-D4.2.6, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [54] Taichi Yamazaki, Taiko Kawakami, MULTILINGUALIZATION OF ASTRAX ACADEMY, IAC-22-E1.7.10, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [55] Taichi Yamazaki, Taiko Kawakami, POSSIBILITY OF ZERO-GRAVITY FLIGHT AND SPACE FLIGHT BY PEOPLE WITH DISABILITIES, IAC-22-E1.9.18, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [56] Taichi Yamazaki, Kentaro Chimura, Taiko Kawakami, DEVELOPMENT OF SPACE TOILET "SPACE BENKING" IN JAPAN, IAC-22-E5.IP.10, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [57] Taichi Yamazaki, Taiko Kawakami, DISASTER PREVENTION AND EVACUATION TECHNOLOGIES ON EARTH AND THEIR APPLICATION TO SPACE TRAVEL, IAC-22-E5.4.9, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [58] Mika Islam, Taichi Yamazaki, CLEANING METHODS FOR REUSING CLOTHES IN SPACE, IAC-22-B3.7.7, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [59] Mika Islam, Taichi Yamazaki, HOW TO GO TO SPACE WITH DIFFERENT HAIRSTYLES, IAC-22-E1.9.7, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [60] Yuko Kirihara, Airi Negisawa, Chieko Takahashi, Taichi Yamazaki, Cocoro Tamura, RESEARCH ON PSYCHOLOGICAL CHANGES AND GROWTH OF CHILDREN THROUGH EDUCATION RELATED TO COMMERCIAL SPACE BUSINESS, IAC-22-E1.IPB.9, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [61] Ayako Kurono, Taichi Yamazaki, WHAT DO THEY NEED FOR A SPACE MUSEUM?, IAC-22-E5.5.8, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [62] Haruto Kurono, Taichi Yamazaki, ESTABLISHMENT AND DEVELOPMENT OF A LUNAR COMMUNITY AND ACTIVITY SPACE BY CHILDREN FOR CHILDREN, IAC-22-D4.2.10, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [63] Akifumi Mimura, Taichi Yamazaki, VIDEO EDITING SERVICES FOR SPACE TRAVELLERS, IAC-22-B3.2.6, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [64] Akifumi Mimura, Taichi Yamazaki, TECHNOLOGIES ON A TRANSPARENT RESTROOM COULD BE USED FOR LUNAR HABITATS, IAC-22-E5.1.8, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [65] Taiko Kawakami, Taichi Yamazaki, ASTRAX LUNAR CITY PROJECT 2022, IAC-22-D3.1.12, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [66] Chikako Murayama, Taichi Yamazaki, THE NEED FOR A SPACE VERSION OF HAND SIGNALS, A COMMUNICATION TOOL FOR SPACE TRAVELERS, IAC-22-B3.2.1, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [67] Chikako Murayama, Taichi Yamazaki, Taiko Kawakami, PHOTOGRAPHY SERVICES AND TECHNIQUES REQUIRED FOR SPACE TRAVEL, IAC-22-D6.1.8, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [68] Chikako Murayama, Taichi Yamazaki, ON IMAGES OF THE UNIVERSE INFLUENCED BY MANGA AND ANIME, IAC-22-E1.9.3, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [69] Hikaru Otsuka, Taichi Yamazaki, A SPACE EDUCATION PROGRAM TO SOLVE THE SHORTAGE OF COMMERCIAL SPACE TEACHERS IN JAPANESE SCHOOLS, IAC-22-

- E1.7.8, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [70] Yasuko Fukushima, Taichi Yamazaki, HOW TO CAPTURE THE COSMIC DIVERSITY THAT IS COMING, IAC-22-E1.9.22, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [71] Chieko Takahashi, Taichi Yamazaki, THE ROLE OF SPACE FLIGHT ATTENDANTS IN LARGE, LONG-DURATION SPACE TRAVEL, IAC-22-B3.2.10, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [72] Kiyomi Shigematsu, Taichi Yamazaki, PROPOSAL FOR A BUSINESS MODEL THAT ENABLES AND ENCOURAGES OLDER ADULTS TO TRAVEL TO SPACE, IAC-22-E5.IP.22, 73rd International Astronautical Congress (IAC), Paris, France, 2022, 18-22 September.
- [73] Taichi Yamazaki, Taiko Kawakami, Fumihiro Oiwa, DEVELOPMENT OF ASTRAX ZERO GRAVITY AIRCRAFT EDUCATION AND TRAINING SIMULATOR, IAC-23-A2.5.9, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [74] Taichi Yamazaki, Taiko Kawakami, DEVELOPING TECHNOLOGY FOR DRINKING CHILLED CARBONATED BEVERAGES IN SPACE, IAC-23-B5.1.11, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October."
- [75] Taichi Yamazaki, Taiko Kawakami, Hiroki Nakaegawa, DEVELOPMENT OF COMMERCIAL SPACERCRAFT EDUCATION AND TRAINING SIMULATOR USING THE METAVERSE, IAC-23-D1.1.6, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [76] Taichi Yamazaki, Taiko Kawakami, CONSTRUCTION PLAN OF ASTRAX LUNAR CITY SIMULATION FACILITY IN JAPAN, IAC-23-D4.2.9, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [77] Taichi Yamazaki, Taiko Kawakami, Kentaro Chimura, DEVELOPMENT OF THE SPACE TOILET CALLED "SPACE BENKING" 2023, IAC-23-E5.4.3, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [78] Taichi Yamazaki, Taiko Kawakami, INTRODUCTION OF COMMERCIAL SPACE R&D CENTER "ASTRAX LAB" IN JAPAN, IAC-23-B3.IP.B.5, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [79] Taichi Yamazaki, Taiko Kawakami, ANALYSIS OF PASSENGERS' NEEDS AND DEMANDS OF ASTRAX ZERO GRAVITY SERVICES AND APPLICATION FOR SPACE TRAVEL SERVICES, IAC-23-B3.IP.1, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [80] Taiko Kawakami, Taichi Yamazaki, THE SENSES AND CREATIVITY THAT CAN BE ACHIEVED BY BRINGING ENTERTAINMENT IN SPACE, IAC-23-E1.IP.22, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [81] Taiko Kawakami, Taichi Yamazaki, TECHNOLOGY, PROBLEMS AND SOLUTIONS FOR DRINKING ALCOHOL IN SPACE, IAC-23-E1.9.2, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [82] Taiko Kawakami, Taichi Yamazaki, TECHNOLOGY, PROBLEMS, AND SOLUTIONS FOR SPACE TRAVEL MEALS AS REPRESENTED BY "YAKITORI", GRILLED CHICKEN, IAC-23-B5.IP.2, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October."
- [83] Taiko Kawakami, Taichi Yamazaki, THE POSSIBILITY OF DEVELOPING JAPANESE CULTURE THROUGH "NATTO" IN SPACE, IAC-23-E5.IP.17, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [84] Hikaru Otsuka, Taichi Yamazaki, LOCAL REVITALIZATION PROJECT TO TURN MY HOMETOWN, KOMONO TOWN, INTO "SPACE TOWN", IAC-23-E1.9.3, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [85] Hikaru Otsuka, Taichi Yamazaki, METHODS AND PRACTICES FOR INTRODUCING PRIVATE SPACE EDUCATION PROGRAMS INTO JAPANESE SCHOOLS, IAC-23-E1.2.8, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [86] Masahiko Takehara, Taichi Yamazaki, DEVELOPMENT OF A "LUNAR PATTERN OKONOMIYAKI" BAKING METHOD TO HELP PROMOTE TOURISM IN A LUNAR CITY, IAC-23-D4.LBA.1, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [87] Masahiko Takehara, Taichi Yamazaki, SPACE EDUCATION AND NUTRITION EDUCATION

- USING "SOLAR PLANET TAKOYAKI, IAC-23-E1.LBA.3, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [88] Masahiko Takehara, Taichi Yamazaki, APPLICATION OF ACTIVITIES ON LUXURY CRUISE SHIPS TO SPACE TOURISM VESSELS, IAC-23-B3.IPB.6, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [89] Masahiko Takehara, Taichi Yamazaki, ASTROLOGY IN THE SPACE AGE: WHAT WILL HAPPEN TO THE HOROSCOPES OF THOSE BORN ON THE MOON?, IAC-23-E1.9.8, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [90] Ayako Kurono, Taichi Yamazaki, Haruto Kurono, EXPLORING THE CONCEPT AND POTENTIAL OF SPACE MUSEUMS FOR PRESERVATION, EDUCATION, AND TOURISM, IAC-23-E5.5.2, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.
- [91] Haruto Kurono, Hikaru Otsuka, Taichi Yamazaki, Ayako Kurono, BUILDING A LUNAR COMMUNITY FOR CHILDREN: CHALLENGES OF COOPERATION AND SIMULATING TEAM BUILDING, IAC-23-D4.2.7, 74th International Astronautical Congress (IAC), Baku, Azerbaijan, 2023, 2-6 October.

**Reference to a website:**

- [76] Website of ASTRAX, Inc., ASTRAX PORTAL, <https://astrax.space> (accessed September 1.2023

## ANALYSIS OF PASSENGERS' NEEDS AND DEMANDS OF ASTRAX ZERO GRAVITY SERVICES AND APPLICATION FOR SPACE TRAVEL SERVICES

Taichi Yamazaki <sup>a\*</sup>, Taiko Kawakami <sup>b</sup>

a CEO and commercial astronaut, International Space Services, Inc. and ASTRAX, Inc., 2-23-17 Komachi,  
Kamakura, Kanagawa, Japan 248-0006,  
taichi.yamazaki@astrax.space

b General Manager, ASTRAX, Inc., 1-1-4-301 Mukogaoka, Bunkyo, Tokyo, Japan 113-0023,  
taiko.kawakami@astrax.space

\* Corresponding Author

### Abstract

ASTRAX's zero gravity flight services are offered in several countries around the world, including the United States, Russia, France, and Japan. ASTRAX, a Japanese private space services company, has been offering ASTRAX's original zero gravity flight service for general customers, not researchers in Japan since 2012, using Diamond Air Services 'small jets. So far, 21 flights have been conducted, and each client has fulfilled various dreams through zero gravity flights. By fulfilling various needs and requests in zero gravity flights, we will be able to fulfill new needs and requests in space travel. Therefore, based on these experiences and experiments, ASTRAX analyzes and predicts the needs and desires of space travelers (what they want to do in a spacecraft, such as weddings, marriage proposals, model shoots, commercial shoots, drinking parties, fashion shows, musical instrument performances, and music concerts), and develops various technologies and services to meet those needs.

This paper describes the results of the analysis of customer needs in zero gravity flights in Japan, the issues derived from the analysis, and the possibility of developing new needs and applying them to commercial spaceflight in the coming space travel era.

ASTRAX 社の無重力飛行サービスは、米国、ロシア、フランス、日本など世界各国で提供されている。日本の民間宇宙サービス会社であるアストラックスは、2012 年からダイヤモンド・エア・サービスの小型ジェット機を使い、日本の研究者以外の一般顧客向けにアストラックス独自の無重力飛行サービスを提供している。これまでに 21 回のフライトを実施し、それぞれの顧客が無重力フライトを通じて様々な夢を実現している。無重力フライトで様々なニーズや要望を叶えることで、宇宙旅行における新たなニーズや要望を叶えることができる。そこで、ASTRAX では、これらの経験や実験をもとに、宇宙旅行者のニーズや要望(結婚式、プロポーズ、モデル撮影、CM 撮影、飲み会、ファッションショー、楽器演奏、音楽会など、宇宙船内で何をしたいか)を分析・予測し、それに応えるための様々な技術やサービスを開発している。

本稿では、日本における無重力飛行における顧客ニーズの分析結果と、そこから導き出された課題、そして来るべき宇宙旅行時代における新たなニーズの開拓と商業宇宙飛行への応用の可能性について述べる。

**Keywords:** ZeroG-Naut, Commercial Astronaut, Mission Commander, Space Flight Attendant, Space Travel, New definition of astronaut

### Nomenclature

ミッションコマンダー: 宇宙船内で乗客のミッションをサポートする民間宇宙飛行士  
ZeroG-Naut: 無重力飛行で乗客のミッションをサポートするクルー

### 1. はじめに

本論文は、2020 年に国際宇宙会議で発表した論文(17)でまとめた、日本における ASTRAX による無重力飛行サービスに参加したお客様のニーズに加え、その後現在までに行った無重力飛行のニーズを追加して分析したものである。

2 項に日本での無重力飛行サービスの概要、3 項に各フライトに共通する ASTRAX によるサービス、4 項にこれまで実施してきた様々なミッションや搭乗者ニーズの分析結果、5 項に課題、6 項に宇宙旅行時代における新たなニーズ開拓、7 項に商業宇宙飛行への応用の可能性、8 項に結論という形でまとめる。

### 2. 日本での無重力飛行サービス概要

ASTRAX の無重力飛行サービスのうち、日本での無重力飛行サービスでは、三菱重工製の MU-300 という小型のジェット機を使用しています。顧客は 3 名搭乗することができます(パイロット 2 名、飛行機会社のフライトアテンダント 1 名、無重力飛行士(STRAX ZeroG-Naut)1 名、顧客 3 名の合計 7 名で飛行)。

無重力飛行を体験する顧客は1回につき3名しかいないので、一人一人が異なる簡易実験や挑戦をすることができます。例えば結婚式やプロポーズしたり、楽器を弾いたり、企業PR撮影したり、コスプレで飛ぶ人、魔法使いになってホウキで飛ぶ人までいました。しかし、これらのニーズに応えるためには、事前の準備や調整、顧客同士の協力と共に、機内でそれぞれのミッションをサポートする無重力飛行士(ZeroG-Naut)の存在が欠かせません。そのサポートと指示により、顧客のミッションの成功率が高まるのです。



図1 ASTRAX の無重力飛行サービス

### 3. それぞれのフライトに共通する ASTRAX のサービス

まず ASTRAX が提供する無重力飛行サービスにおいて、それぞれの飛行に共通で顧客に提供しているサービスや準備作業、技術には以下のようないがあります。

- ・事前準備(集客、連絡、ロゴ、グッズ、レター、ガイドライン、顧客情報管理、発注業務、各種手配、健康診断、健康管理、書類管理、チームビルディングなど)
- ・シミュレーターによるリハーサル(STRAX 無重力飛行機シミュレーターを利用した事前チェックを行う)
- ・プリフライトサービス(ヒヤリング、移動サポート、メンタルチェック、メンタルサポートなど)
- ・インフライトサービス(メンタルサポート、撮影サポート、実験サポート、アクションサポート、飛行中のリアルタイム調整・交渉など)
- ・ポストフライトサービス(移動サポート、ラグジュアリーパーティー、特別認定書作成及び授与式の開催、宿泊サポートなど)
- ・ポストフライト影響確認(通常生活復帰後の影響評価)
- ・アフターサービス(映像や写真の共有、映像編集など)

これらは個々の搭乗者のニーズに関わらず、共通して提供されるサービスです。3.3 項に、個別の搭乗者(あるいはフライト)による、それぞれのミッションを示します。

### 4. これまで実施してきた様々なミッションや搭乗者ニーズ

まず、全フライトを通して、共通で実施されるサービス(無重力体験以外)のものとして、記念写真撮影、月の重力体験、火星の重力体験があります。(ただし、月の重力や火星の重力を実施するかどうかは顧客の要望の有無や、顧客の体調や疲労度、あるいは飛行時間の制約などによって決まります)

次に、ASTRAX 無重力飛行サービスに参加した顧客が、これまでに無重力で行った様々な実験やミッションを以下に紹介します。

#### (1) 機器・器具・機能実験(無重力で使えるか・無重力でできるかを判断)

- 血圧計測実験
- 化粧水塗布実験
- アクセサリー(プレスレット)拳動実験
- アクセサリー(ネックレス)拳動実験
- 小型医療機器通信実験
- CASIO 腕時計実験
- CASIO デジタルカメラ実験
- SEIKO 腕時計実験
- スマートフォン通常撮影実験
- スマートフォン浮遊撮影実験
- 新型無重力フライトスーツ実証実験
- 腕相撲実験
- 集合写真撮影用器具(1号機)実証実験
- 薬の調合実験(2液混合)
- 集合写真撮影用器具(2号機)実証実験
- 新型宇宙フライトスーツ実証実験
- シャボン玉の色つけ実験
- プロペラ模型飛行機飛行実験
- 竹とんぼ飛行実験(その1)
- 扇子飛行実験(3種類)
- 集合写真撮影用器具(3号機)実証実験(その1)
- 集合写真撮影用器具(3号機)実証実験(その2)
- 模型飛行機飛行実験
- 竹トンボ飛行実験(その1)
- ドロップの缶の実験
- 宇宙食ドッキング実験
- 水風船+炭酸水+スポンジ実験
- カクテルグラス実験
- 事前説明会実施検証
- コルセット装着実験
- アイマスク装着実験
- 現金浮遊実験
- スマートフォン浮遊撮影実験(その2)
- イラスト描画実験
- ブーメラン実験

水と油の混合実験  
水と泡の混合実験  
血圧計測実験  
心電図測定実験  
しわの実験  
首コルセット装着実験  
カツラ離脱実験(その1)  
カツラ離脱実験(その2)  
無重力スクーター飛行実験(その1)  
ハンドスピナー飛行実験  
無重力スクーター飛行実験(その2)  
無重力スクーター飛行実験(その3)  
端子接続実験  
水中ドローン飛行実験(報告書作成)  
水中ドローン操作性検証実験  
アレンジメントフラワー実験  
視覚障害者用杖実験  
玉子を割る実験  
メダカの泳法実験  
インコの飛行実験  
ハンドスピナー実験(時間がなくて未実施)  
扇風機飛行実験  
ドーナツ型水風船を割って形状を観察する実験  
くす玉を割る実験  
くるりんワンちゃん実験(時間がなくて未実施)

## (2) アクション・スポーツ(無重力ができるか)

回転飛行実験  
スーパーマン的飛行実験  
水飲み実験  
宇宙カレー試食実験  
魔法使いのホウキでの飛行実験  
無重力人間テニス実験  
風船による飛行実験  
団扇による飛行実験  
空飛ぶ絨毯実験  
魔法使いのホウキでの飛行実験  
ピンポン実験  
鉄アレイ実験  
ハリーポッターのホウキ飛行実験  
シャンプーボトルでお茶を飲む実験  
ピンポン大会  
フライテスツから抜ける実験(ルパン三世のシーン)  
浮遊実験  
縄跳び実験  
Macbook(3台)プログラミング実験  
ピンポン実験  
通常浮遊実験  
陶器の器で丂ごはん(おにぎり)を食べる実験  
紙飛行機搭乗飛行実験  
折り鶴搭乗飛行実験  
ブレーブボード飛行実験  
スーパーマン飛行実験  
キャンディ制作実験

ビニール飛行機搭乗飛行実験  
ハンディ掃除機による空間掃除実験(企業PR用撮影)  
窓拭き実験(企業PR用撮影)  
マジック実験  
社交ダンス実験(その1)  
带回し実験  
バック転実験  
フラフープ潜り実験  
カクテルグラス実験  
書を書く実験  
スケートボード実験  
水泳実験  
カツラ実験  
カレーを食べる実証実験  
火星の重力→月の重力→無重力段階的飛行実験  
前方宙返り実験  
水を飲む実験  
ボクシング実験  
浮遊実験  
靴磨き実験  
視覚障害者による無重力飛行実験  
視覚障害者支援技術習得実験  
無重力におけるクロール泳法実験  
さつまいもチップスを食べる実験  
社交ダンス実験(その2)  
月の重力でジャンプ実験  
幽体離脱感覚検証実験(その1、その2)  
書き初め実験  
ラーメンを食べる実験  
平泳ぎ実験  
ワインを飲む実験  
オムレツにケチャップをかける実験  
ソフトクリームを作る実験

## (3) コスプレ浮遊実験

AKB48  
天使  
装飾品実験(帽子、サングラス  
魔女の宅急便  
ドラゴンボール  
ハリーポッター(図1)  
迷彩服  
ロケット王子のマント  
水着  
阪神タイガース応援法被  
スーパーマン  
マント  
初音ミク  
ルウ王子  
カップラーメン  
サンタクロース  
のび太  
貞子

FP レンジャー  
ドクターの白衣  
スパイダーマン  
マント  
もうやんカレー衣装  
天使(その1~3)



図 2 ハリー・ポッターの衣装で無重力飛行

#### (4) 衣装浮遊実験

紳士服  
新型無重力フライトスーツ  
着物(浴衣)  
新型無重力フライトスーツ(劇団宇宙食堂舞台衣装)  
着物  
ふんどし水着  
オリジナルフライトスーツ

#### (5) 楽器演奏実験

ヴァイオリン  
ギター  
ヘルマンハープ  
リコーダー  
ブルースハープ(ハーモニカ)

#### (6) 物品 PV撮影実験

ミネラルウォーター  
書籍(その1)  
チラシ  
書籍(その2)  
金の延棒  
お札  
書籍(その3)  
パスポート  
キャンディ  
書籍(その4)  
コルセット  
パンツ  
タオルケット  
有機雑穀米  
シウマイ弁当

セサミン  
本  
アメ  
犬のぬいぐるみ

#### (7) 企業&個人 PR用動画撮影

Macbook プログラミング実験(IT企業)  
掃除機による空間掃除実験(ビルメンテナンス企業)  
無重力状態での窓拭き実験(ビルメンテナンス企業)  
世界初の無重力マジック撮影(マジシャン)  
着物 & ふんどしグラビア撮影実験(モデル)  
アライブン PR撮影(健康促進用品企業)  
斎田皮膚科 PR撮影(病院 PR用)  
宇宙旅行者 PR撮影(宇宙ワーママ PR用)  
もうやんカレーPR撮影(ウクレレ、歌、カレーを食べる)  
田村建設 PR撮影(ユニフォーム旗)  
ミュージックビデオ用撮影  
映画ドラえもん PV撮影  
冷やしやきいも撮影  
さつまいもチップス撮影

#### (8) 撮影機材検証実験

CASIO デジタルカメラ実験  
スマートフォン無重力通常撮影実験  
スマートフォン無重力浮遊撮影実験(その1)  
ヘッドマウントカメラ撮影実験(その1)  
ヘッドマウントカメラ撮影実験(その2)  
360度カメラ撮影実験  
一眼レフ撮影実験(ニコン)  
スマートフォン無重力浮遊撮影実験(その2)  
3Dカメラ撮影実験(その1)  
3Dカメラ撮影実験(その2)  
GoPro撮影実験(HERO10, HERO 11)  
LED照明実験  
OSMO POCKET撮影実験  
CANON 広角カメラ撮影実験  
ハンディカム撮影実験  
DJI ジンバルカメラ撮影実験

#### (9) 各種ミッション

世界初無重力プロポーズ  
義足飛行検証(その1)  
最年少記録更新(11歳)  
家族の絆実証実験  
最年少記録更新(10歳)  
引きこもり対策実証実験  
連日飛行実証実験(その1)  
社員同士飛行検証(社長と部長)  
日本人顧客対応検証(日本からの移動、宿泊、通訳など)

大人数顧客対応検証(日本での少人数飛行との違い)  
義足飛行検証(その 2)  
連日飛行実証実験(その 2)  
夫婦飛行検証(その 1)  
夫婦飛行検証(その 2)  
社員同士飛行検証(社長及び社員)  
親子飛行検証(母と娘)  
家族飛行実証(父・母・娘)  
カップル飛行実証  
民間宇宙飛行士訓練  
宇宙旅行訓練(その 1)  
無重力フライトアテンダント体験実験  
無重力フライトアテンダント体験実験  
宇宙旅行訓練(その 2)  
宇宙旅行訓練(その 3)  
宇宙旅行訓練(その 4)  
宇宙旅行訓練(その 5)  
無重力フライトアテンダント訓練  
宇宙旅行訓練(その 6)  
視覚障害者飛行検証

## 5. 課題

日本での 11 年にわたる 21 回の無重力飛行サービスにおいて、搭乗者のニーズに応えるための課題としては、以下のようなものが挙げられる。

- ・1 人 150 万円というコスト
- ・3 人しか乗れないという搭乗人数の少なさ
- ・飛行機会が限定されている
- ・パラボリック回数の少なさ
- ・マーケットの小ささ
- ・実験機としての制限
- ・搭乗可能な国籍  
(離発着する飛行場が軍事施設のため)
- など

## 6. 宇宙旅行時代における新たなニーズ開拓

2021 年から民間による宇宙旅行が始まり、すでにたくさんの宇宙旅行者が宇宙飛行を行っている。宇宙飛行を行った搭乗者の中には、自分の GoPro カメラを持参したものもいるし、国際宇宙ステーションに旅行した前澤友作氏は非常にたくさんの実験を行ったりもしています。

今後、さらに多様なミッションが行われることが想定されますが、その際、3 項に示す無重力飛行におけるニーズや、そのニーズに応える技術が応用できると考えています。そのためにも、ASTRAX では、今後以下のよう準備を行うことで、さまざまな宇宙船に合わせた新しいニーズを開拓していく必要があると考えている。

- ・実際の宇宙船を模擬した内装シミュレーターによる事前検証(ハード及びソフト)

- ・ミッションに合わせたスキルを持った無重力飛行士の養成
- ・ミッションコマンダーや宇宙船フライトアテンダントの養成
- ・ニーズ共有・分析ポータルシステム
- ・さまざまな技術サポートサービス

## 7. 商業宇宙飛行への応用の可能性

3 項に示す無重力飛行におけるさまざまなニーズの中から、宇宙飛行においても高い需要がありそうなものをピックアップしてみた。

これらは、単純に無重力飛行や宇宙飛行を体験するだけの需要ではなく、高額な資金を払ってでも実施したいというニーズが想定されるものであり、幅広い層の一般顧客に対してニーズとなり得るものと考えている。

- ・旅行者のイメージトレーニング
- ・宇宙での結婚式
- ・宇宙でのプロポーズ
- ・宇宙での葬儀
- ・宇宙でのコンサート
- ・CM 撮影
- ・映画撮影
- ・TV 撮影

## 8. 結論

宇宙旅行時代が始まると、顧客は安全上問題がなければ、あらゆる要望を要求することになります。お金を払えば基本的になんでもできるからです。例えば宇宙にペットを連れて行く人もいるかもしれないし、子供がサイエンスプロジェクトの宿題として、宇宙で昆虫の実験を行いたいと言うかもしれません。飛行機に乗るのは異なり、地球とは全く異なる重力環境であるため、地球上の生物にとって、とんでもない進化を起こすような環境の変化になるかもしれません。

そう言ったこれまでにないような様々な要望に応えるため、重要なのは、パイロットではなく、顧客のサポーターとして一緒に搭乗するキャビンクルー(アテンダント)の方です。(今後民間宇宙船はどんどん自動化が進み、パイロットがいなくても飛べるようになると考えています)。

何度も宇宙飛行をしたことがある顧客であれば、その人たちだけでなんでもできるようになるかもしれません、となるまでにしばらく時間がかかるので、それまでは必ずミッションコマンダーや宇宙フライトアテンダントが必要になると考えられます。

ASTRAX では実際の宇宙で活躍できるあらゆる立場の人材(カメラマンやシェフ、歌手や科学者、など)を育てるために、専用の訓練設備や教育システム、ツールを用意しています。同行するミッションコマンダーや宇宙フライトアテ

ンダントもそのシステムやサービスの一環として考えています。

そしてこのミッションコマンダーや宇宙フライターチームのようなお客様をサポートする役割は絶対になくななりません。なぜならこれから人類の活動領域が広がるにつれて、その都度必ず水先案内人（あるいは山登りガイドやシェルパのような人）が必要となるからです。そして、経験が豊富になればなるほど、顧客のニーズに応えられるレベルも高くなり、成功率も高くなるからです。

今後、宇宙旅行時代が始まり、宇宙でのニーズと、それを実現させるためのサポート人材の役割がどんどん細分化されていくでしょう。ここで定義した役割や名称もまた変わると思いますが、まずは現時点での、一般人搭乗者による無重力飛行におけるさまざまなニーズと、無重力飛行士や民間宇宙飛行士の必要性についてまとめてみました。今後も世界の動向を見ながら本論文も改訂していく予定です。本論文がこれからの民間宇宙旅行産業の発展につながればと思います。

## 参考文献

### 学会/国際会議論文

【1】民間商業宇宙飛行士と新規宇宙ビジネスの展開について

【2】Overview Of ASTRAX Space Services Including Over 50 Space Businesses,  
50以上の宇宙事業を含む ASTRAX の宇宙事業の概要

【3】ASTRAX Zero Gravity Flight Services In Japan,  
日本における ASTRAX 無重力飛行サービス

【4】ASTRAX Lunar City Development Project, ASTRAX 月面都市開発プロジェクト

【5】ASTRAX Space Services Platform By Using Blockchain Technology,  
ブロックチェーン技術を活用したアストラックス宇宙サービスプラットフォーム

【6】ASTRAX Universal Service Platform By Using Blockchain Technology,  
ブロックチェーン技術を活用した ASTRAX のユニバーサルサービスプラットフォーム

【7】Mission Control Center To Support Commercial Space Missions And Passenger'S Activities Inside Of The Cabin,

商業宇宙ミッションと乗客の機内活動を支援するミッションコントロールセンター

【8】ASTRAX Academy And Space Business And Space Flight Support Educational System,  
ASTRAX ACADEMYと宇宙ビジネス・宇宙飛行支援教育システム

【9】Mission Support Control Center And Suborbital Spacecraft Simulator To Support Commercial Space Missions And Customer Activities,  
商業宇宙ミッションと顧客活動を支援するミッション支援管制センターとサブオービタル宇宙船シミュレータ

【10】Zero G-Naut And Mission Commander To Support Commercial Space Missions And Customer Activities Inside Cabin,  
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【11】“Space Scooter”: Space Mobility System Used In Space Hotels And Space Stations,  
「スペーススクーター」宇宙ホテルや宇宙ステーションで使用される宇宙移動システム

【12】ASTRAX Lunar City Development Project 2020,  
ASTRAX 月面都市開発プロジェクト 2020

【13】ASTRAX Lunar City Economic System By Using Blockchain Technology,  
ブロックチェーン技術を活用した ASTRAX 月面都市経済システム

【14】ASTRAX Space Service Catalog System For Space Tourism,  
宇宙旅行のための ASTRAX 宇宙サービスカタログシステム

【15】ASTRAX Universal Service Platform By Using Blockchain Technology,  
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【16】Experience And Lessons Learned From The Covid-19 Problem In Japan And Application To Space Travel,  
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【17】Zero-G-Naut And Mission Commander To Support Commercial Space Mission And Customer Activities Inside Cabin,

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【18】Creating A New Business Of Space Flight  
Attendant Service & SFA Academy,  
スペースフライトアテンダントと SFA アカデミーという新しいビジネスの創出

【19】The Importance Of Kimono In Space, 宇宙での着物の重要性

【20】What Women Need For Space Travel,  
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【21】ASTRAX Lunar City Development Project 2021  
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【22】Commercial Space Mission Support Control  
Center and Suborbital Spacecraft Simulator to Support  
Commercial Space Missions and Passengers Activities  
in Space  
商業宇宙ミッションと宇宙での搭乗者の活動をサポートするための商業宇宙運用支援管制センターとサブオービタル宇宙船シミュレーター

【23】Initiative of development of the Solar System  
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【24】Space Fashion and Space Culture in the Age of  
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Hagoromo”  
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【25】Making ASTRAX ACADEMY Online and  
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【26】Potential Future Plan of Space Izakaya as a Place  
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【30】Prototype plans for various commercial spacecraft  
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【31】Experiments on Coloring Soap Bubbles under  
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【32】Study of the selection of location for commercial  
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【33】Space Radiation Shielding by Water Dome in  
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【34】Introduction of a practical example of ASTRAX  
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【35】Development of a Civilian Spacecraft Interior  
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マインクラフトを用いた民間宇宙船内部シミュレーターの開発

【36】Proposal to Add a Space Economics  
Subcommittee to the UN Office for Outer Space  
Affairs' Committee on the Peaceful Uses of Outer  
Space(COPUOS in UNOOSA)  
国連宇宙局の「宇宙空間の平和利用に関する委員会」(COPUOS in UNOOSA)に「宇宙経済小委員会」を追加する提案

【37】The Gender Gap and Its Impact in Manga, Anime  
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【39】The Effects of Using Minecraft to Teach Children about Space  
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【40】Maintaining the Health of Pilots and Crew  
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【41】Consideration on the Creation of a Chicken Egg Market at the Moon Village  
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【42】Consideration of the future prospects of the Space Flight Attendant (SFA) profession with the expansion of space travel marketing  
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【43】Problems and Solutions that are Preventing More Women from Becoming Space Tourists  
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【44】人工衛星を使用した宇宙時代の平和思考と社会経済学(ワスマイルファンデーションシステム)

【45】最新型宇宙サービスアクセスアプリケーションツール「ASTRAX U2U (Universal User Interface)」

【46】Development of a Teripper for intra-spacecraft transportation,  
宇宙船内移動用テリッパの開発

【47】Possibility of Zero-Gravity Flight Service by MRJ (Mitsubishi Regional Jet),  
MRJによる無重力飛行サービスの可能性

【48】Development of ASTRAX commercial spacecraft education and training simulator,  
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【49】Development of Space Shower,  
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【50】Production of space suits and replicas for space travel,  
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【51】ADVANCED SPACE SERVICE ACCESS APPLICATION TOOL "ASTRAX UNIVERSAL USER INTERFACE (ASTRAX U2U)",

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「ASTRAX Universal User Interface (ASTRAX U2U)」

【52】ASTRAX Solar System Economic Bloc Concept using NFT and Metaverse Technologies,  
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【53】Development of a Real-life (Analog) ASTRAX Lunar City Construction Project in Japan,  
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【54】Multilingualization of ASTRAX ACADEMY, ASTRAX ACADEMY の多言語化

【55】Possibility of zero-gravity flight and space flight by people with disabilities,  
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【56】Development of Space Toilet "Space BENKING" in Japan,  
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【57】Disaster prevention and evacuation technologies on Earth and their application to space travel,  
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【58】Cleaning Methods for Reusing Clothes in Space, 宇宙で衣類を再利用するための洗浄方法

【59】How to Go to Space with Different Hairstyles, さまざまなヘアスタイルで宇宙へ行く方法

【60】Research on Psychological Changes and Growth of Children through Education Related to Commercial Space Business,  
商業宇宙事業に関連した教育による子どもの心理的変化・成長に関する研究

【61】What do they need for a space museum?, 宇宙ミュージアムに必要なものは?

【62】Establishment and development of a lunar community and activity space by children for children, 子どもによる子どものための月面コミュニティ・活動空間の構築と発展

【63】video editing services for space travellers, 宇宙旅行者のためのビデオ編集サービス

【64】technologies on a transparent restroom could be used for lunar habitats,  
透明なトイレの技術は、月面基地にも応用できる

【65】ASTRAX Lunar City Project 2022,  
ASTRAX 月面シティプロジェクト 2022

【66】The need for a space version of hand signals, a communication tool for space travelers,  
宇宙旅行者のコミュニケーションツール、宇宙版ハンドシグナルの必要性

【67】Photography services and techniques required for space travel,  
宇宙旅行に必要な写真撮影サービス・技術

【68】On images of the universe influenced by manga and anime,  
マンガやアニメの影響を受けた宇宙像について

【69】A space education program to solve the shortage of commercial space teachers in Japanese schools,  
日本の学校における民間宇宙講師不足を解消するための宇宙教育プログラム

【70】How to capture the cosmic diversity that is coming,  
これからやってくる宇宙の多様性をどう捉えるか

【71】The Role of Space Flight Attendants in Large, Long-duration Space Travel,  
大規模・長期間の宇宙旅行におけるスペースフライトアテンダントの役割

【72】Proposal for a business model that enables and encourages older adults to travel to space,  
高齢者の宇宙旅行を実現・促進するビジネスモデルの提案

【73】Development of ASTRAX Zero Gravity Aircraft Education and Training Simulator  
ASTRAX 無重力飛行機教育訓練シミュレーターの開発

【74】Developing technology for drinking chilled carbonated beverages in space  
宇宙で炭酸飲料を飲むための技術開発

【75】Development of commercial spacecraft education and training simulator using the Metaverse メタバースを利用した民間宇宙船教育訓練シミュレーターの開発

【76】Construction plan of ASTRAX LUNAR CITY Simulation Facility in Japan 日本における ASTRAX 月面シティシミュレーション施設の構築計画

【77】Development of the space toilet called "Space Benking" 2023  
宇宙用トイレ「宇宙ベンキング」の開発 2023

【78】Introduction of commercial space R&D center "ASTRAX LAB" in Japan  
日本における民間宇宙開発センター「ASTRAX LAB(アストラクスラボ)」の紹介

【79】Analysis of passengers' needs and demands of ASTRAX Zero Gravity Services and application for space travel services  
無重力飛行サービスに対する乗客のニーズ・要望の分析と宇宙旅行サービスへの応用

【80】The senses and creativity that can be achieved by bringing entertainment in space  
宇宙空間でエンターテイメントを実現することで得られる感覚と創造性

【81】Technology, problems and solutions for drinking alcohol in space  
宇宙空間でお酒を飲む際に必要な技術と問題点および解決方法

【82】Technology, problems, and solutions for space travel meals as represented by "yakitori", grilled chicken  
焼き鳥に代表される宇宙旅行での食事に必要な技術と問題点および解決方法

【83】The Possibility of Developing Japanese Culture through "NATTO" in Space  
宇宙空間における納豆を通じた日本文化の展開の可能性

【84】Local revitalization project to turn my hometown, Komono Town, into "space town"  
故郷の菰野町を「宇宙の町」にする地方活性化プロジェクト

【85】Methods and Practices for Introducing Private Space Education Programs into Japanese Schools  
民間宇宙教育プログラムを日本の学校現場に導入する方法と実践

【86】Development of a "lunar pattern okonomiyaki" baking method to help promote tourism in a lunar city

月面シティの観光振興に貢献する「月面模様お好み焼き」の焼き方開発

【87】Space Education and Nutrition Education Using  
"Solar Planet Takoyaki"  
「太陽系惑星たこ焼き」を利用した宇宙教育と食育

【88】Application of activities on luxury cruise ships to  
space tourism vessels  
豪華客船内アクティビティの宇宙観光船への応用

【89】Astrology in the Space Age: What will happen to  
the horoscopes of those born on the Moon?  
宇宙時代における占星術 月生まれの人のホロスコープは  
どうなるの？

【90】Exploring the Concept and Potential of Space  
Museums for Preservation, Education, and Tourism  
保存・教育・観光のための宇宙ミュージアムのコンセプトと  
可能性を探る

【91】Building a Lunar Community for Children:  
Challenges of Cooperation and Simulating Team  
Building 子どものための月面コミュニティづくり：協力への  
挑戦とチームビルディングの模擬体験

**Reference to a website:**

【92】Website of ASTRAX, Inc., ASTRAX PORTAL,  
<https://astrax.space> (accessed September 1.2023)