Spring Semester 2005

13.4.2005 (first: Fall Semester 2004)

S·P·A·C·E TOURISM II™

Lecture Series given by Dr.-Ing. Robert Alexander Goehlich

ようこそ

スペース ツーリズム II レクチャー へ

– Part 1: Introduction –

General

The Reason why I am here...

Welcome to Ohkami Lab

Space System Engineering

R. Goehlichさんとの出会いなど

- フランスで開催された宇宙大学で出会う(02/05)
  宇宙開発の将来について語り合う
- Ph.D学生時代に「宇宙旅行」を出版(02/05)
- 日本学術振興会（JSPS）の
  外国人特別研究員としてSD
  学科に滞在(03/09-05/08)
- 宇宙開発の市場性、コスト等
  についてオープンな講義を
- 活発な質問と討論を期待

2003/11/05

SD学科教授　狼　嘉彰

General

Contact

Dr.-Ing. Robert Alexander GOEHLICH
Mobile: +81-(0)90 1767 1667
Fax: +81-(0)45-566-1778
Email: mail@robert-goehlich.de
Internet: www.robert-goehlich.de

Ms. Akiko FUJIMOTO (Teaching Assistant)
Mobile: +81-(0)80-5039-6222
Email: af07302002@yahoo.co.jp

Mr. Kenji HASEGAWA (Webmaster)
Mobile: n.a.
Email: malayzaru@hotmail.com

Keio University
Department of System Design Engineering
Ohkami Laboratory
(Space System Engineering)
Office 14-609/14-620
3-14-1 Hiyoshi
Kohoku-ku
Yokohama 223-8522
JAPAN

Content

- **General**
- **Introduction**
  - Goal Definition of this Lecture
  - Summary of each Lecture
- **Definition (Repetition)**
  - Space Tourism
  - Space
- **Project STMS II**
- **News: SpaceShipOne and Wildfire**
- **Requests from Audience for Lectures**

Introduction

Goal Definition of this Lecture

In contrast to “Space Tourism I” lecture, the goal is to discuss selected topics such as “Ansari X Prize”, “Space Adventures”, “Tourist Module on ISS” etc. in detail. The lecture is complemented by various guest speakers from universities and industries (Kawasaki Heavy Industries, JAXA, Space Tourism Society Japan, etc.) as well as using the Space Tourism Market Simulation II.

Introduction

Summary of each Lecture (Part 1)

Week	Date	Topic	Short Description
1	13.4.	Introduction	short summary of each lecture, Space Tourism Market Simulation, requests from audience for lectures
2	20.4.	Ansari X Prize, SpaceShipOne and Wildfire	Lecture and Space Tourism Market Simulation
3	27.4.	Space Tourism and Policy	Lecture and Space Tourism Market Simulation
4	11.5.	Intermediate Student Presentations	(Grading)
5	18.5.	Space Tourism in California	by Mr. Saotome, President of Space Tourism Society Japan, USA
6	25.5.	Future Space Transportation Systems + Intermediate Student Presentations	by Mr. Hirokazu Suzuki, Senior Researcher, Future Space Transportation Research Center, JAXA, Tokyo, Japan + (Grading)

Introduction

Summary of each Lecture (Part 2)

Week	Date	Topic	Short Description
7	1.6.	Space Tourism OPOLY	Guest Speaker: Mr. Tony Webb, founder of eSpaceTickets.com and eSpaceLotto.com, Wilmington, USA (Webcam broadcasting)
8	8.6.	Present and Future Spaceports	by Mr. Iida, formerly Head of Kagoshima Space Center, now Advisor to the Executive Director of JAXA, Tokyo, Japan
9	15.6.	Suborbital Rocket Plane + Intermediate Student Presentations	by Prof. Yoshiaki Ohkami, Keio University, Yokohama, Japan + (Grading)
10	22.6.	Space Adventures	Lecture and Space Tourism Market Simulation
11	29.6.	The Universe and Space Tourism	Guest Speaker: Dr. Knud Jahnke, Astrophysical Institute Potsdam, Germany (Webcam broadcasting)
12	6.7.	NASA and U.S. Industry: Space Tourism and Beyond	by Mr. A.C. Charania, Senior Futurist, SpaceWorks Engineering Inc., Atlanta, USA
13	13.7.	Conclusion	Lecture and Space Tourism Market Simulation

Definition

Definition of Space Tourism (Version I)

„Space tourism is the term broadly applied to the concept of paying customers traveling beyond Earth's atmosphere.“

Example:

Dennis Tito can be seen as the first space tourist. His arrival at the International Space Station in April 2001 is shown in the figure.

Definition

Definition of Space Tourism (Version I)

(movie)

Definition

Definition of Space Tourism (Version II)

No. 11

"Space tourism can be defined to include not only the vehicles that take public passengers into space, but also from the perspective of the "destination" paradigm. As such, the industry can be envisioned to include not only earth-based attractions that simulate the space experience such as space theme parks, space training camps, virtual reality facilities, multi-media interactive games and telerobotic moon rovers controlled from Earth, but also parabolic flights, vertical suborbital flights, orbital flights lasting up to 3 days, or week-long stays at a floating space hotel, including participatory educational, research and entertainment experiences as well as space sports competitions (i.e. space Olympics)." (Space Policy Institute, 2002)

Example:

Space camp at the Yuri Gagarin Cosmonaut Training Center at the Russian Star City. Training in a neutral buoyancy hydrolab for $7000 is shown in the picture.

Definition

Definition of Space Tourism (Version II)

No. 12

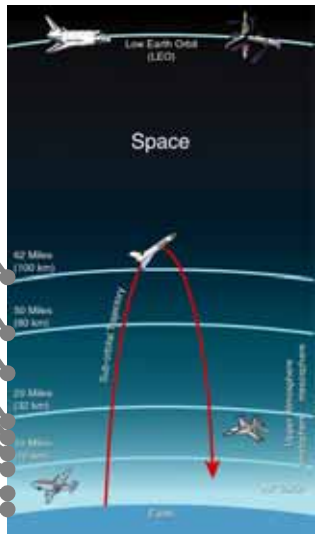
(movie)

Definition

Where does Space begin?

Definition varies between nations and organizations concerning different points of view. In this lecture, it is defined as 100 km above sea level.

- 100 km: no aerodynamic forces
- 81 km: astronaut wings (US DoD)
- 45 km: rocket engine necessary
- 32 km: turbo ramjet necessary
- 24 km: oxygen bottle necessary
- 20 km: pressurized cabin necessary
- 16 km: pressure suit necessary
- 5,3 km: supplemental oxygen necessary
- 3 km: human is not operating efficiently



Project STMS II

General

- **Space Tourism Market Simulation II (STMS II) is an interactive simulation covering various disciplines such as rocket engineering, economics, design, laws, ethics, art, etc.**
- **Participants can choose one out of eight specific groups.**
- **They can either cooperate or compete with other groups.**
- **The idea of STMS II is to improve participant's knowledge and skills of space tourism in the fields of strategic decision-making, engineering, teamwork, marketing and entrepreneurial activities.**

Project STMS II

Available Groups

Project STMS II

Structure

Info Kit (Example)

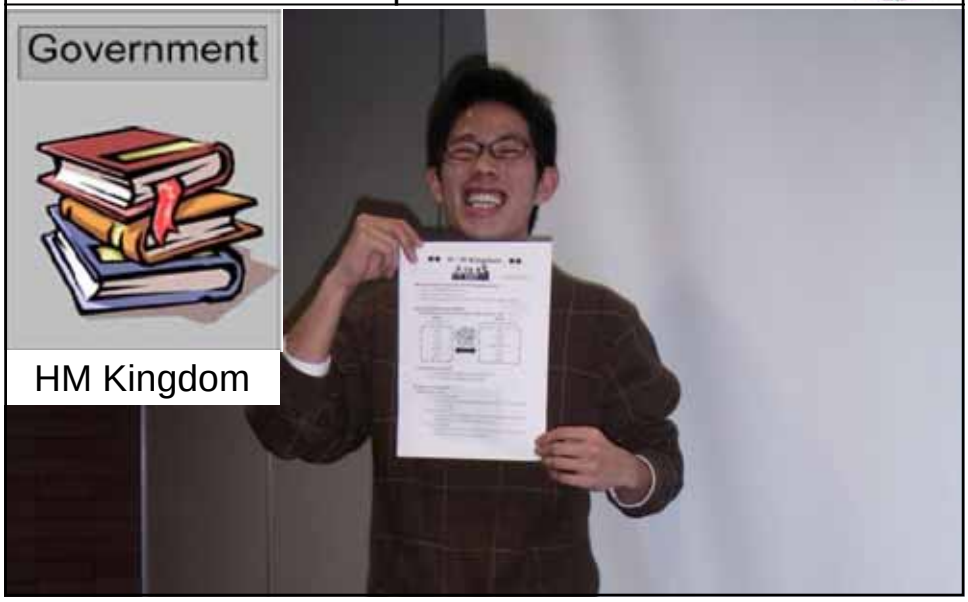
Discussion Kit (Example)

Project STMS I (Example)

Who will make the Space Tourism business?

Project STMS I (Example)

Who will make the Space Tourism business?

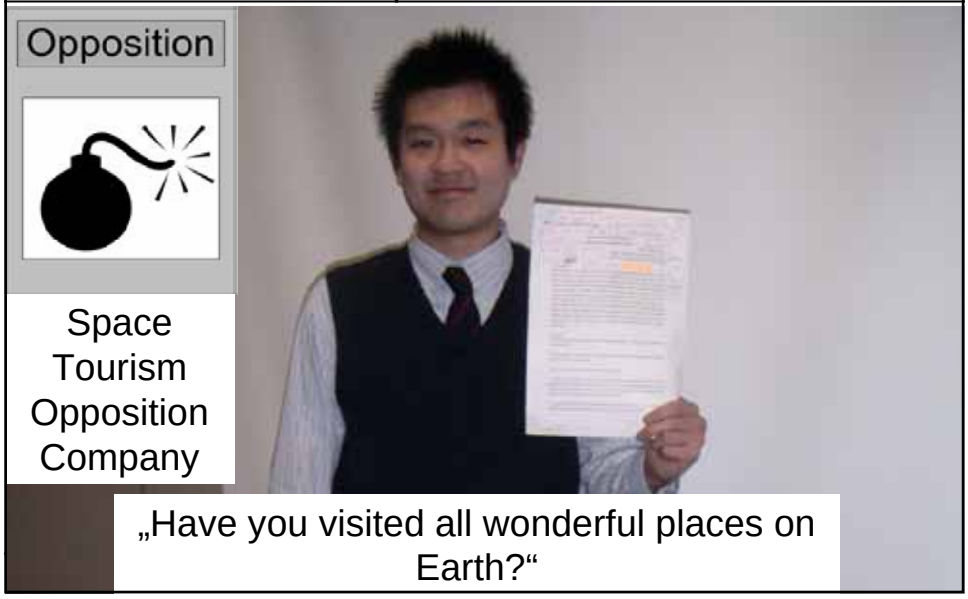


Project STMS I (Example)

Who will make the Space Tourism business?

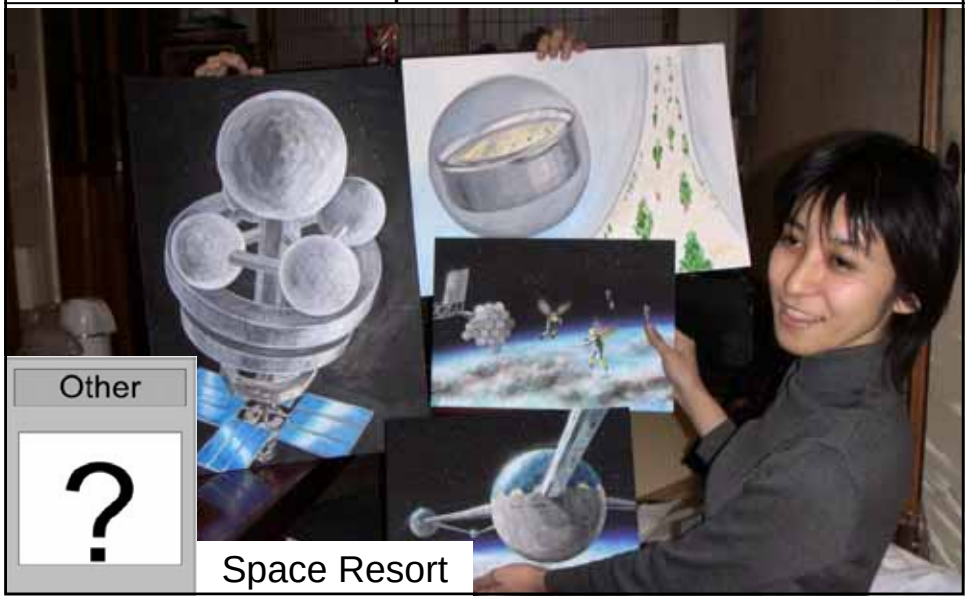
Project STMS I (Example)

Who will make the Space Tourism business?



Project STMS I (Example)

Who will make the Space Tourism business?



Special: SpaceShipOne

Logbook (planned)

- June 21, 2004: First suborbital flight
- September 29, 2004: Ansari X Prize Flight #1 (called X1)
- October 4, 2004: Ansari X Prize Flight #2 (called X2)
- from 2007: Virgin Galactic regular suborbital flights by using SpaceShipOne technology

(Scaled Composites)

Special: SpaceShipOne

Design of White Knight

No. 23

Features/Capabilities

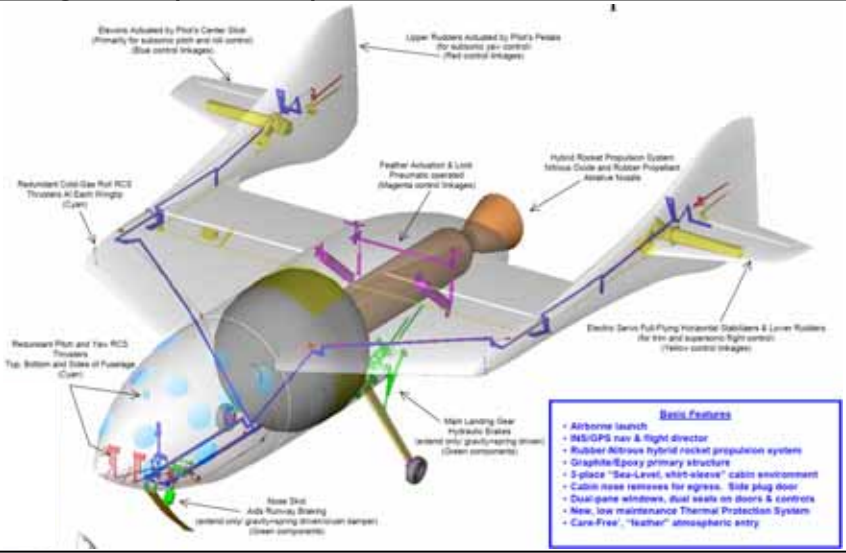
- Carriage & launch of payloads up to 8,000 lb
- Internal fuel capacity up to 6,400 lb
- Altitude capability above 53,000 feet
- Large, three-place cabin (60" dia outside, 59" inside)
- Sea level cabin qualified for unlimited altitude
- ECS scrubs CO_2, removes humidity and defogs windows
- Two crew doors with dual seals & dual-pane windows
- Manual flight controls with three-axis electric trim
- Avionics include INS-GPS nav, flight-director, flight test, data (recording & T/M), air data, vehicle health monitoring, backup flight instruments, & video system
- Propulsion is two afterburning J-85-GE-5 engines
- The 82-ft wing can be extended to 93-ft for increased climb capability
- Super-effective, pneumatically actuated speed brakes allow steep descent with L/D < 4.5
- Hydraulic wheel brakes and nose-gear steering
- Low-maintenance, leak-proof, landing gear shock absorbers (pneumatic main gear retraction)
- Dual-bus electrical power system
- Simple fuel system requires no in-flight fuel management
- Cockpit allows single-pilot operation (VMC-day conditions only)

(Scaled Composites)

Special: SpaceShipOne

Design of SpaceShipOne

No. 24



(Scaled Composites)

Special: SpaceShipOne

Mission Control

(Scaled Composites)

Special: SpaceShipOne
Typical Launch Schedule

No. 27

7:00 am: White Knight takes off from Mojave spaceport, California with SpaceShipOne fixed underneath. No other planes are allowed to fly near the spaceport when this is happening. SpaceShipOne and White Knight can each carry three people, and the cockpits are identical for training purposes. For the ANSARI X PRIZE flights, there will be two people on board White Knight (1 pilot and 1 co-pilot), and one pilot on SpaceShipOne.

(Scaled Composites)

(Scaled Composites)

Special: SpaceShipOne
Typical Launch Schedule

No. 28

8:00 am: Upon reaching 15 km, the White Knight co-pilot pulls the handle which releases SpaceShipOne from under its belly. A short countdown begins and on “Blast off!”, the pilot / astronaut on board SpaceShipOne ignites the rocket engine and it shoots straight up to 100 km in about 3 minutes. As it climbs, SpaceShipOne appears as a white streak in the sky.

(Collis)

(Scaled Composites)

Special: SpaceShipOne
Typical Launch Schedule

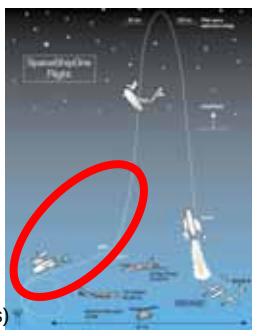
8:03 am: SpaceShipOne is now over 7 times higher than White Knight - at this altitude, the air is so thin that the wings of SpaceShipOne can no longer provide any control, so the astronaut has to use jets of gas to steer the spacecraft. The astronaut will clearly see the darkness of space and the curvature of the earth through the window. He'll experience weightlessness for about 3-4 minutes and if he throws some M&M's about the cabin they will float in front of his face.

(Scaled Composites)

Special: SpaceShipOne
Typical Launch Schedule

8:15 am: Approximately 15 minutes later, SpaceShipOne is back over Mojave at about 13 km. Often a sonic boom can be heard as it returns from space, because the spaceship is traveling faster than the speed of sound as it re-enters the atmosphere.

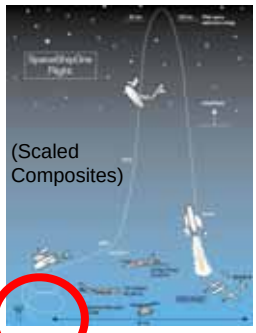
(Scaled Composites)



Special: SpaceShipOne
Typical Launch Schedule

8:30 am: Roughly 90 minutes after take-off, SpaceShipOne lands back on the same runway. It glides back down as it has no fuel left, so the pilot only has one chance to make a good landing.

(Scaled Composites)



(Scaled Composites)

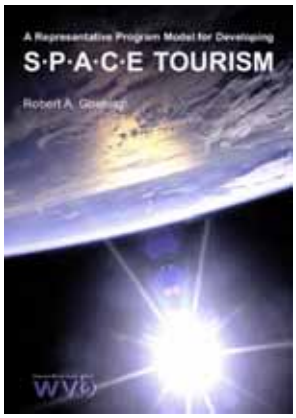
Special: Wildfire
Logbook (planned)

- October 2: Temporary hold

(Scaled Composites)

Lecture`s Textbook

- Paperback Version
- Price: 2500 Yen
- More info:
  - www.amazon.de
  - www.robert-goehlich.de



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Dr.-Ing. Robert Alexander GOEHLICH
Keio University
Department of System Design Engineering
Space System Engineering
3-14-1 Hiyoshi, Kohoku-ku
Yokohama 223-8522, JAPAN
email: mail@robert-goehlich.de
Mobile: +81-(0)90-1767-1667
Fax.: +81-(0)45-566-1778
Internet: http://www.robert-goehlich.de