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One Platform Development of Nano-Satellite with Fusion 360

DE501720：Develop HEPTA-Sat Training Program Using Autodesk Fusion 360 as a Platform

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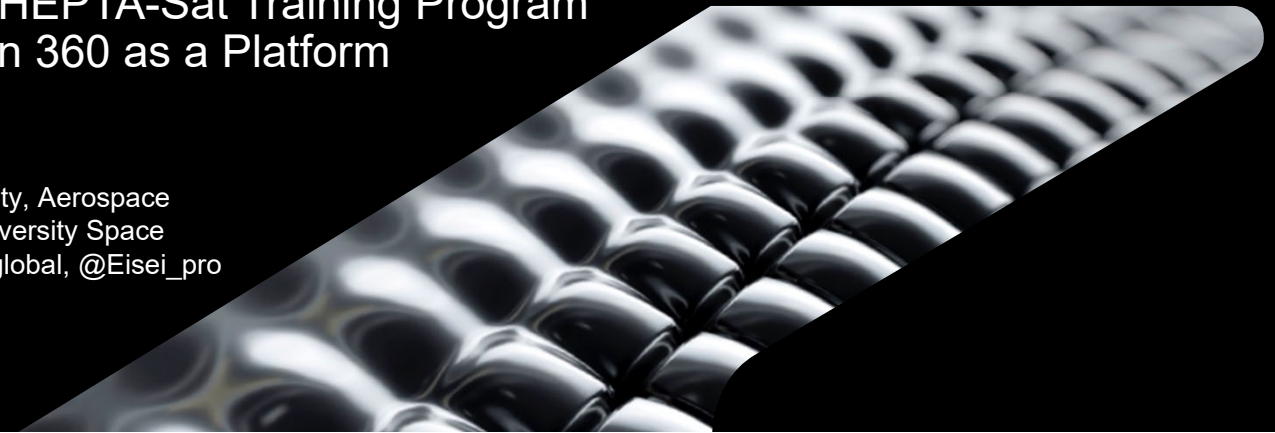
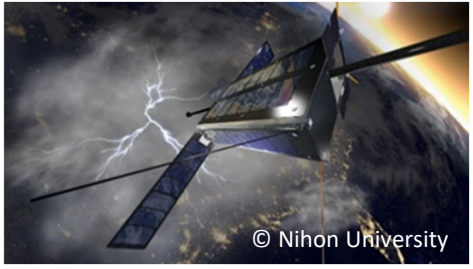


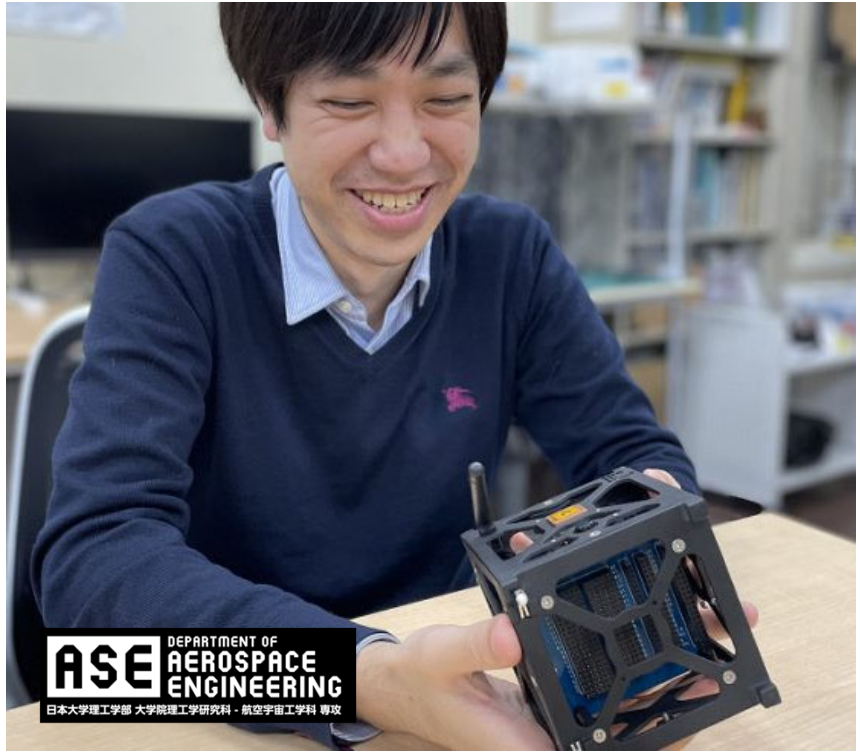
Prof. Masahiko Yamazaki, Ph. D.

- Associate Professor, Aerospace Engineering at the Nihon University, Japan.
- Board Member of UNISEC (University Space Engineering Consortium) .
- Research subject: Systems engineering for small spacecraft development, utilization and education.

Educational CubeSat



Precursory Electric field observation CubeSat




Have you ever wanted to
Create Your Own Satellite?
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One Platform CubeSat Development

We Aim to Spread Our Cutting-Edge Research Methods Through Education

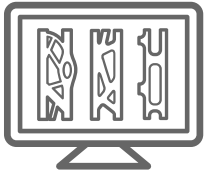
Fusion 360

Accessible

Discovering
The Space/Satellite
Development Industry **More Accessible**

Digital Collaboration

Discovering
New Forms of
Digital Collaboration
With Autodesk Products



Synergy with AI

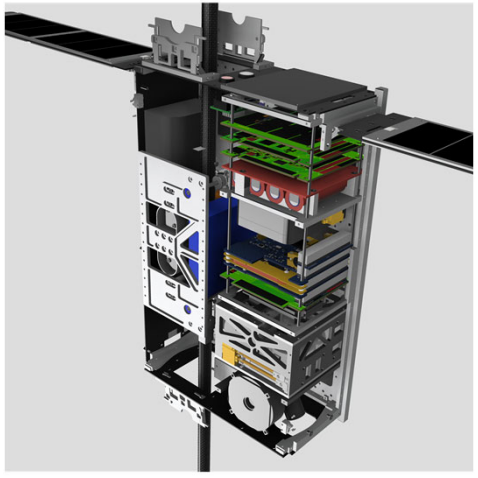
Discovering
Unlimited Potential By
Merging AI Into Existing Technology

Introducing Our Three Projects

We Aim to Spread Our Cutting-Edge Research Methods Through Education

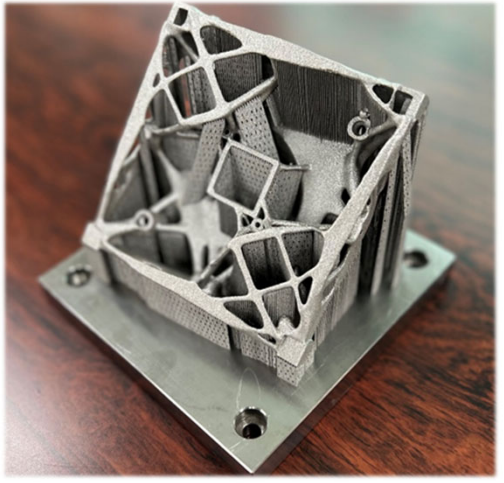
CubeSat

Precursory Electric field Observation Satellite



Generative Design

Generative design of Satellite Structure



Satellite Training

Satellite Engineering Training Package


CubeSat Development
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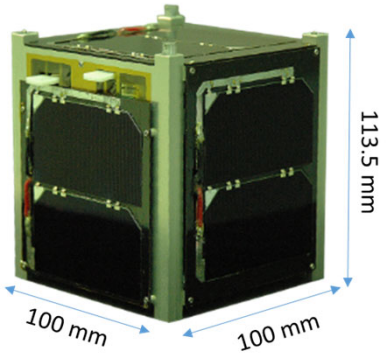
CubeSat

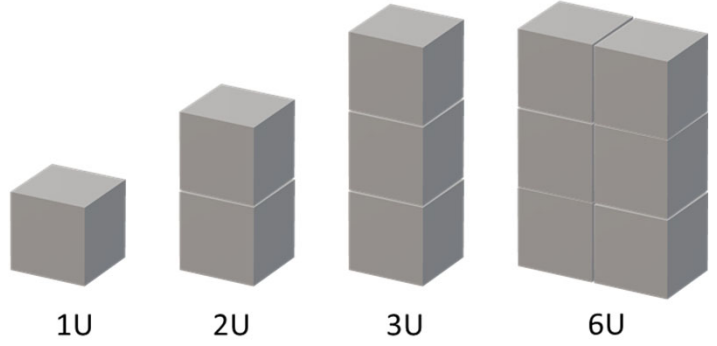
1U CubeSat is a 10 cm cube with mass of approximately 1 to 1.33 kg

- A CubeSat is a type of miniaturized satellite that controls factors such as its ***shape, size, and weight***.

- A CubeSat has the merit of having a lower cost & a shorter period of development. Thus, CubeSat has contributed to a number of ideas and proposals, such as educational, scientific, technological verification, and commercial missions.



1U CubeSat SEEDS-II © Nihon University



Standard sizes of CubeSat

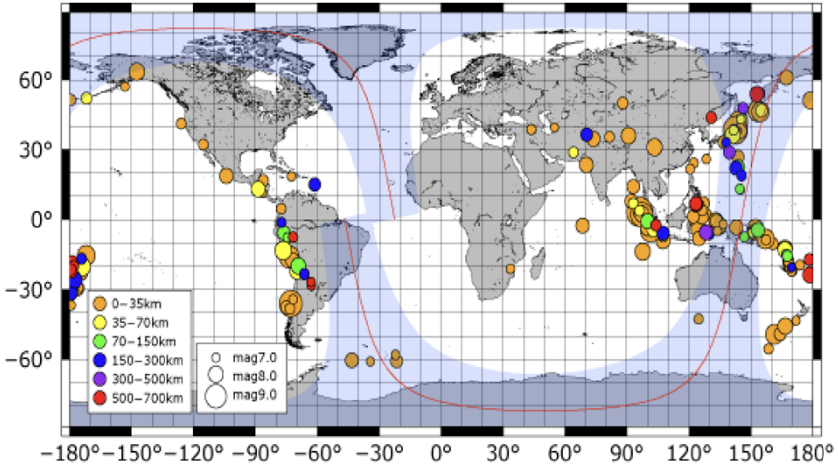
CubeSat x Precursory Electric field observation

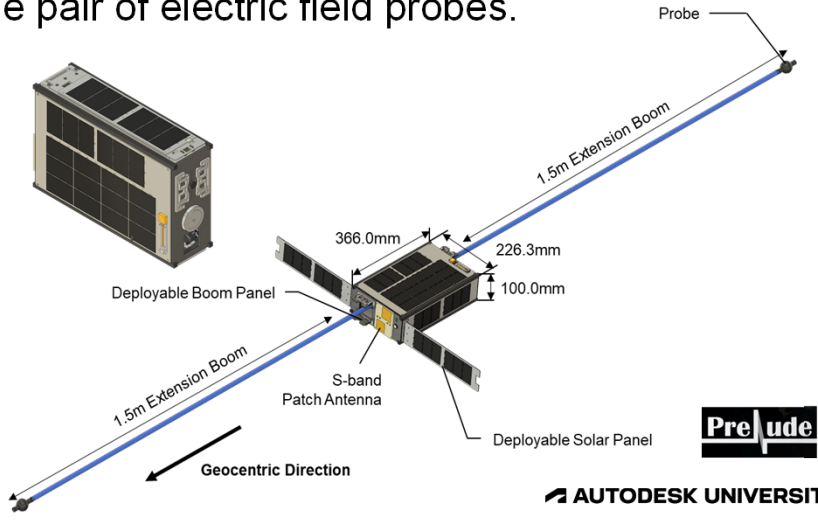
Probabilistic short-term earthquake prediction by observing ionosphere

Open design x Technology Transfer x Dense monitoring network from constellation

- Short-term earthquake prediction is essential for disaster mitigation and requires precursor detection. Satellite precursor observation is useful for EQ prediction.

- The 6U CubeSat "Prelude" is aimed at verifying the reduction of radio wave intensity 4 hours before earthquakes by installing only one pair of electric field probes.

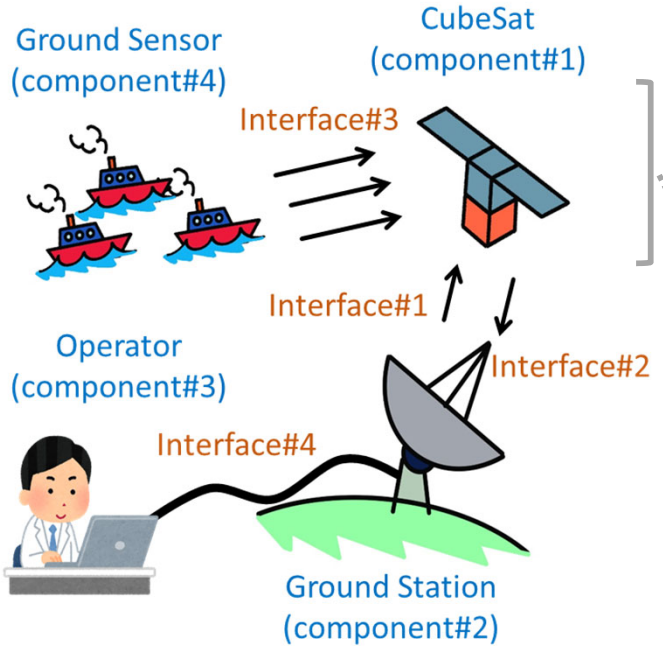


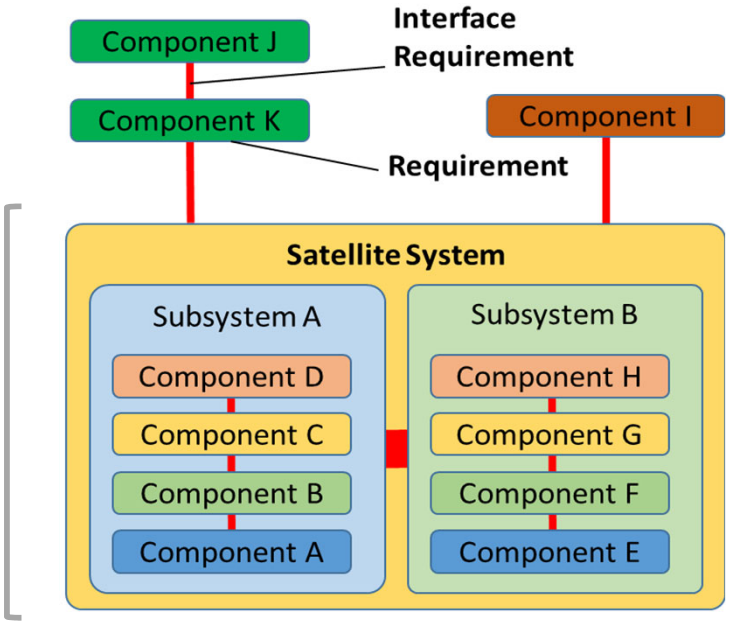


CubeSat System Complexity

Composed of Various Elements and Interfaces

- The **CubeSat system** comprises of hardware, software, people, data, services, and many other elements that work together to achieve a goal.

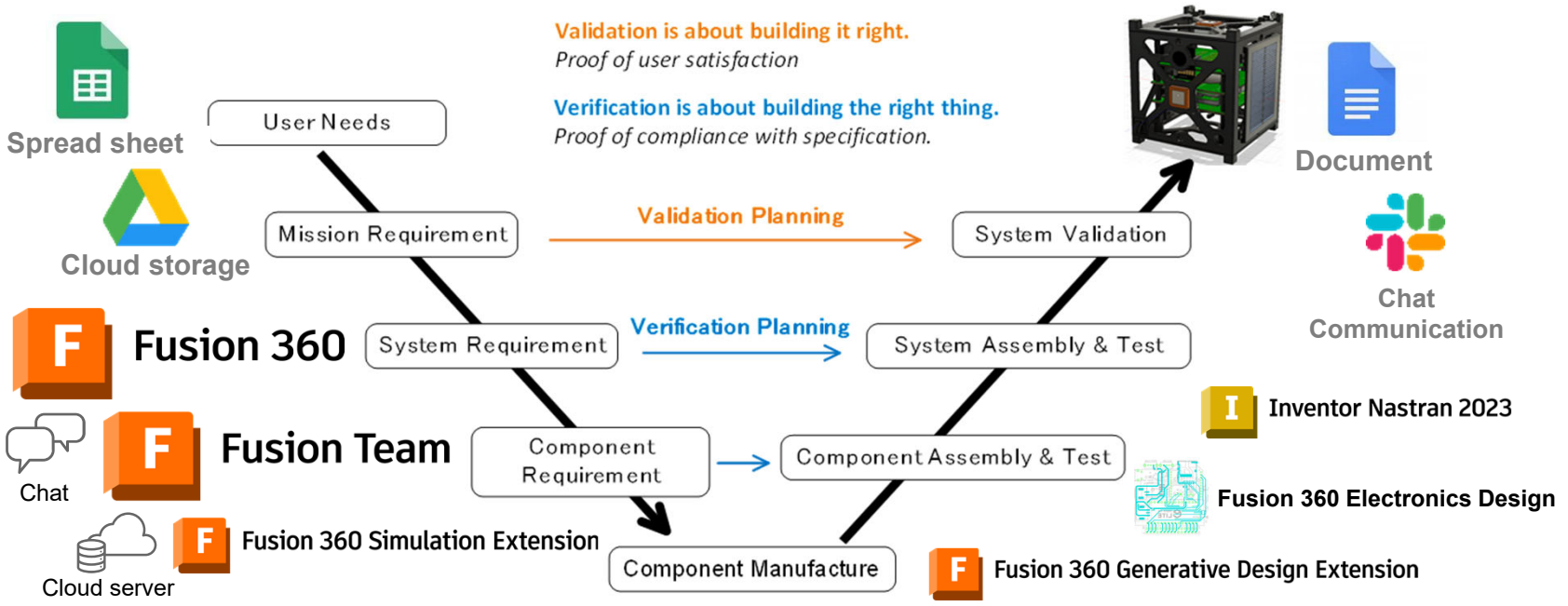




Digital Collaboration for CubeSat Development

Combination of various design & development frameworks

- Our hardware, software, and project design management tools:

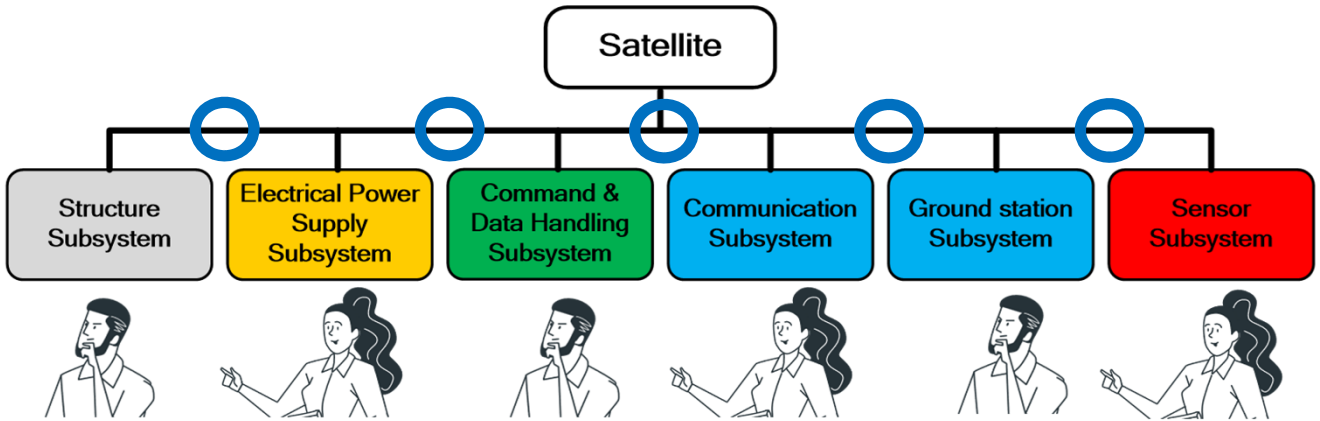


Achieving local and global optimization

Fusion Team's digital collaboration capabilities

- For developing the space systems (such as CubeSat), it is important to have **insights into both local and global optimization**.

- **Fusion Team's digital collaboration capabilities** allowed for the digital connection of design information for different components, subsystems, and interfaces within the CubeSat system, facilitating local and global optimization.



One platform development with Fusion Team

- **“Fusion Team” facilitates the sharing of design information and seamless communication of development.** e.g., reflecting from electronic circuit design to structural design to adjust equipment layout

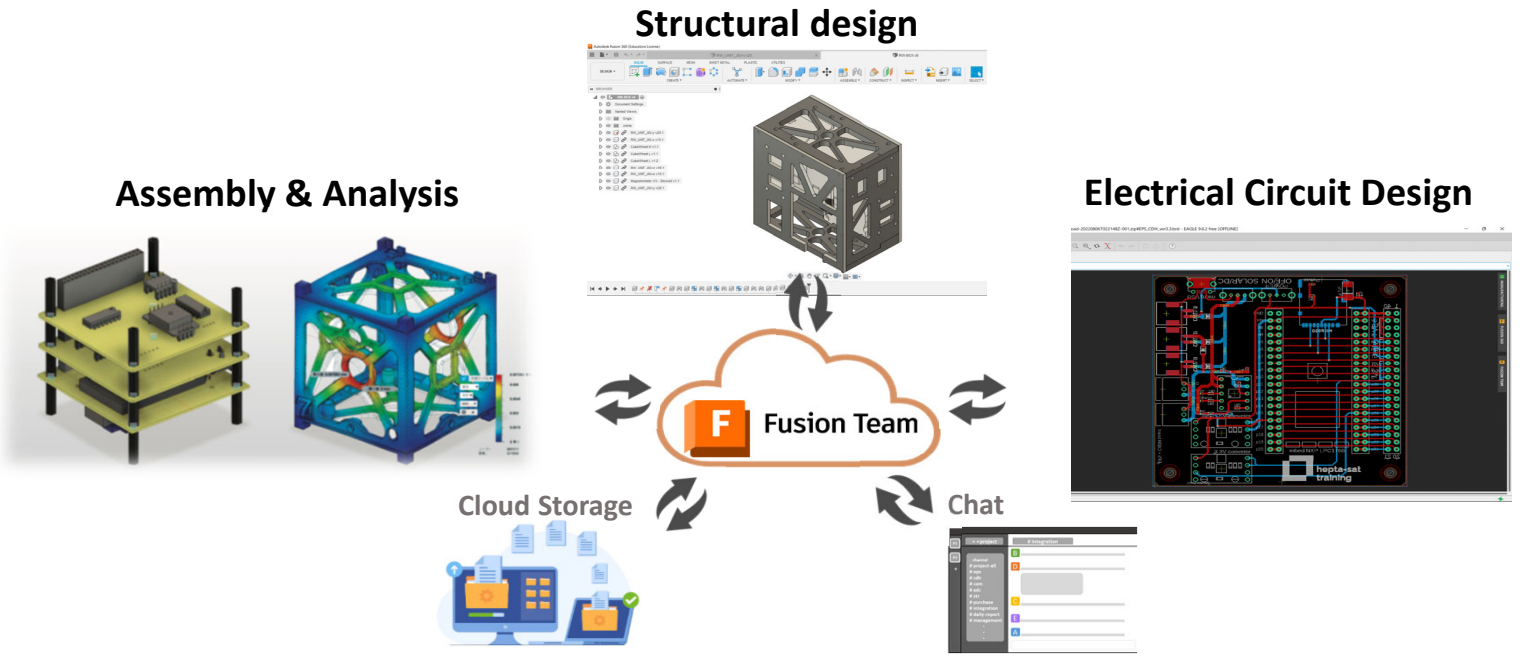
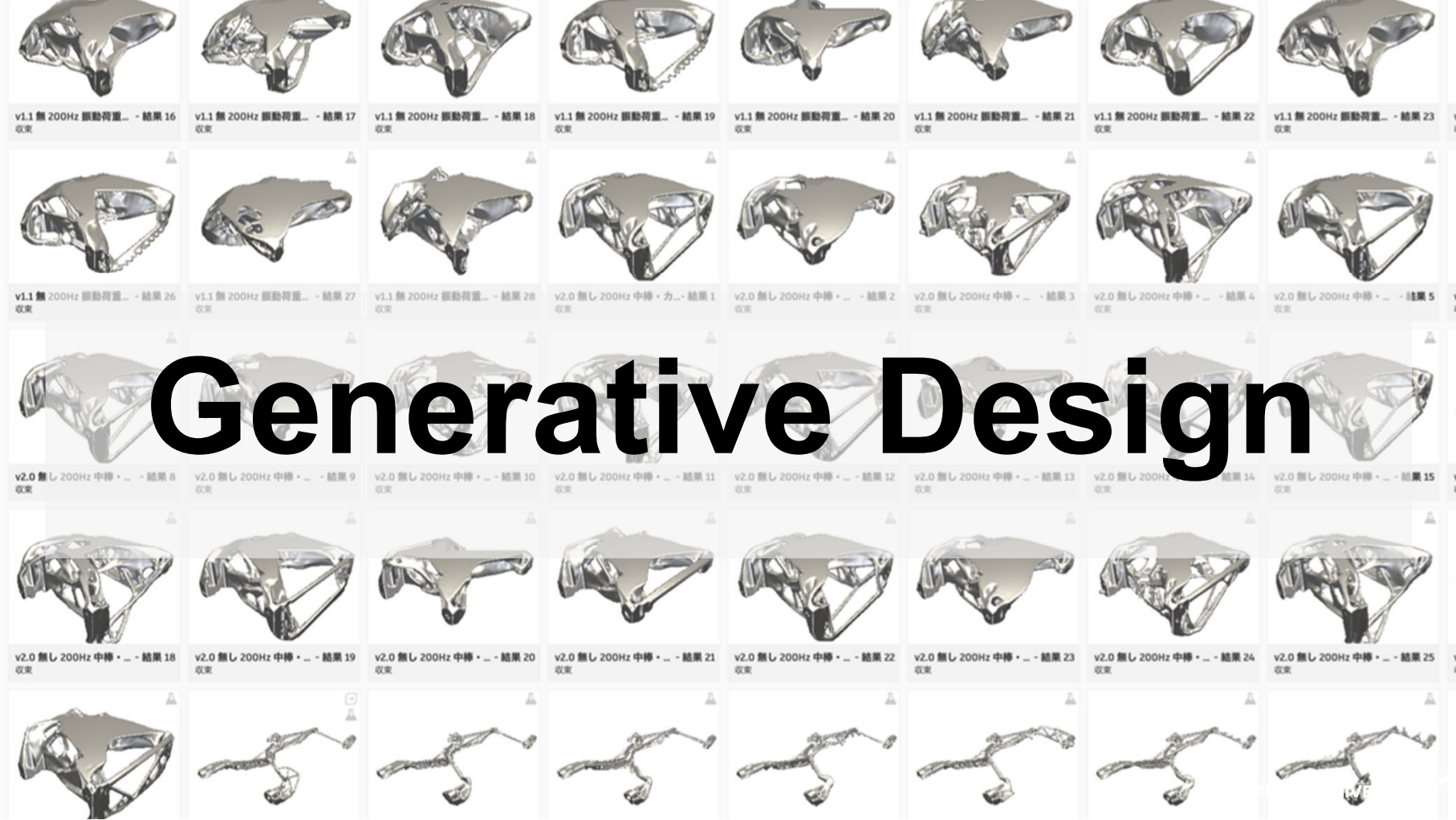
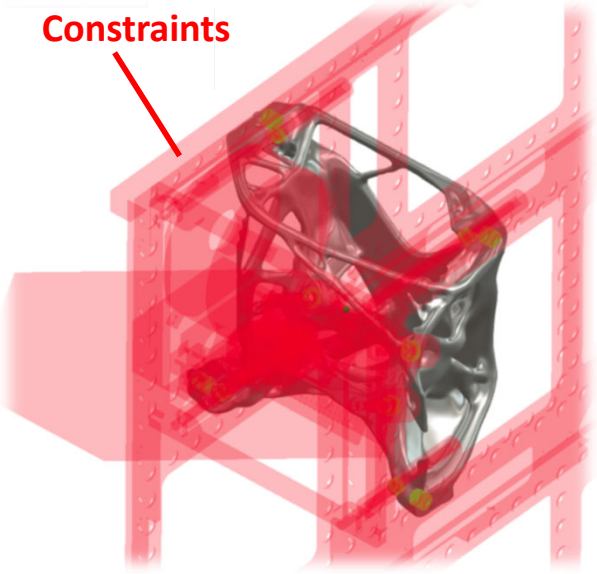


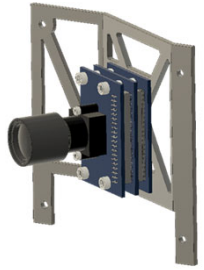
Diagram of Seamless Design Coordination with Fusion Team


Generative Design

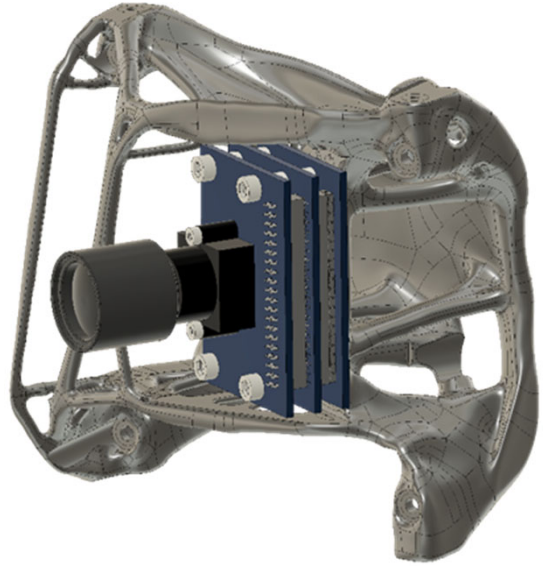
Overview of Fusion 360 Generative Design

- “Generative design” is the computational technology in which computers become a **"member of the development team”** to work alongside humans in order to **quickly find the optimal solution**.





Conventional



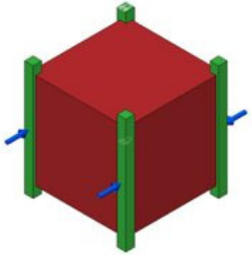
Generative Design

Camera (Star Tracker) support structure design

Synergy of Human knowledge and AI

Easy to transform design ideas into creation

Computer assisted design makes it **easier** to have **design perspective of a professional engineer**.

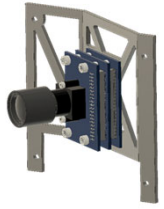


Input(Requirement and Constraint**)**

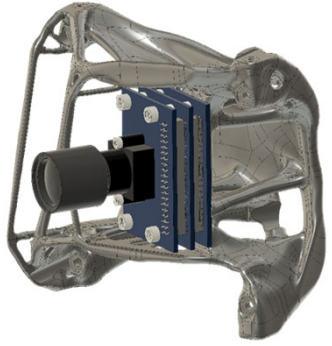
Output(Design Solution)

Find a new design solution

AI Assisted design suggests **design solutions** that are **different from what humans can come up with**.



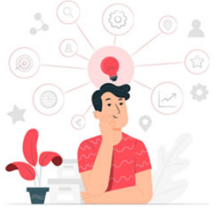
Conventional Design



Generative Design

Designing with AI through a series of interactions

Through **interaction with the AI**, human can **interpret the answers** given by the AI and provide **feedback to the design together with the AI**.



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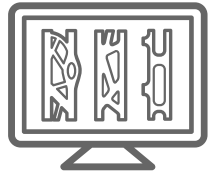
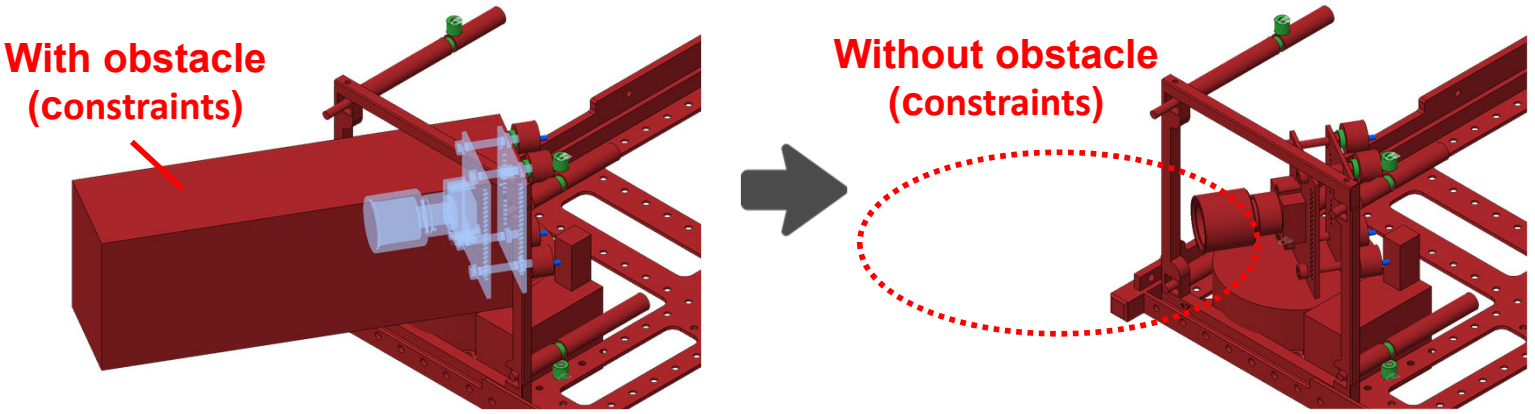


Key Points of Generative Design Challenges

Carefully obstacle geometry (red) area set-up conditions.

- It is easier to obtain **better suggestions through generative design** when **humans do not intentionally impose too many constraints**, as the solution space of the design is expanded.

- **Quickly repeat the design cycle in an "interactive" manner without too many constraints**. (repeat the interaction with the proposed solution)



Suggestions to Improve Generative Design
Further Acceleration of Interaction

- **One of the advantages** of generative design is the **"interactive design" process**, but with current technology, **it takes about a day to generate a single design**.

- **Interaction without delay is the key to seamless design improvement**.

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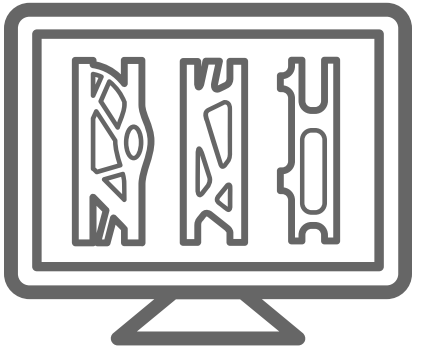

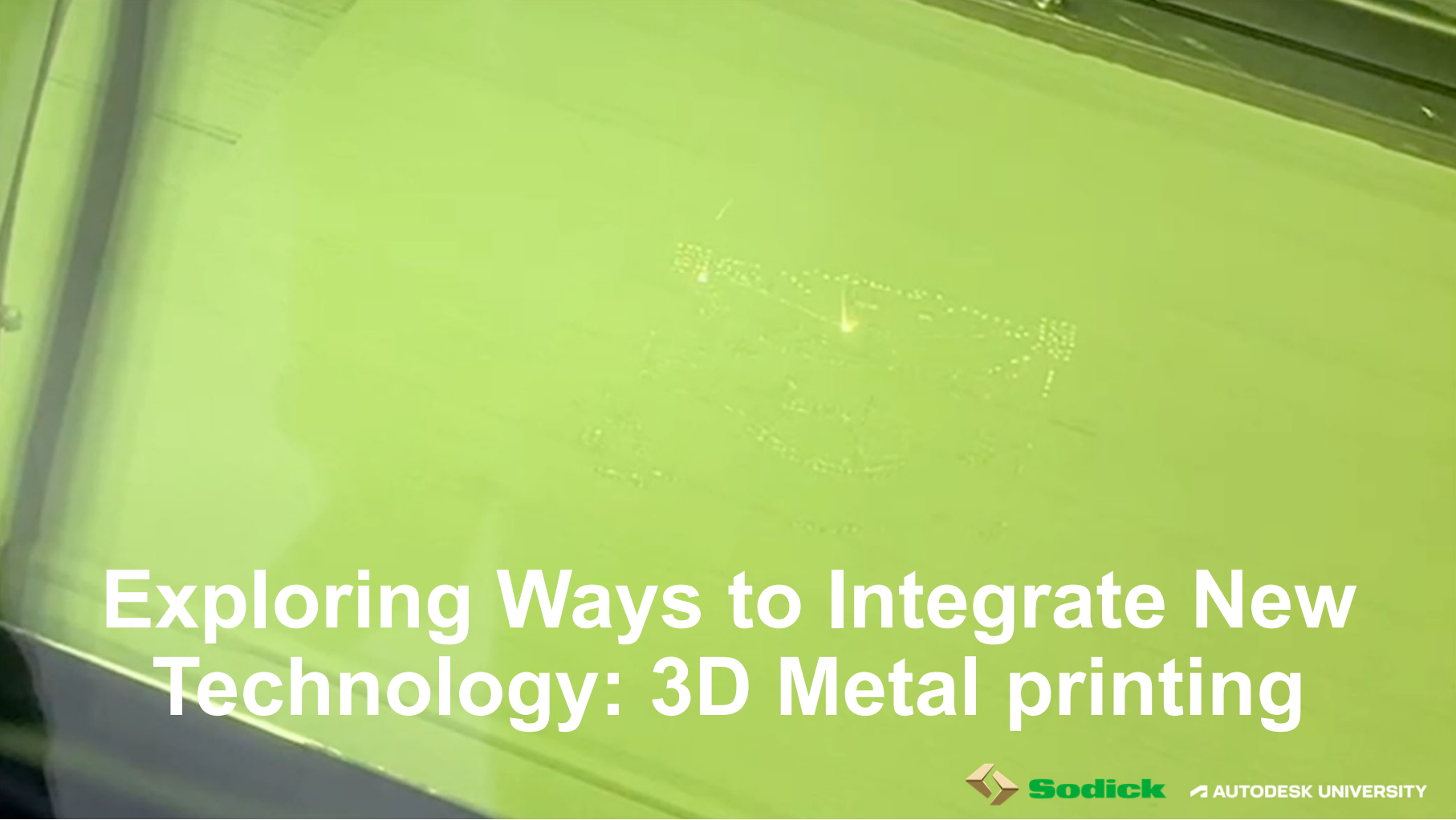

Exploring Ways to Integrate New Technology: 3D Metal printing

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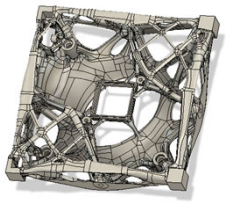
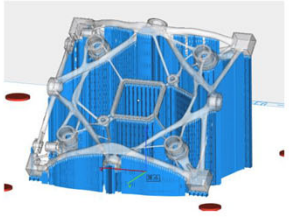
Manufacturing Method of 3D Metal Printing



Generative Design

① Density, angle, support materials

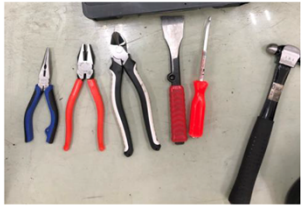


② Stress relief annealing material 350℃ 2-hours

350℃ 2H

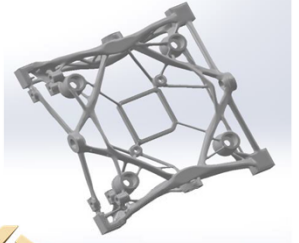
③ Detach from plate

④ Remove support



⑤ Shot Blast Surface Treatm

⑥ Detailed dimensions are machined

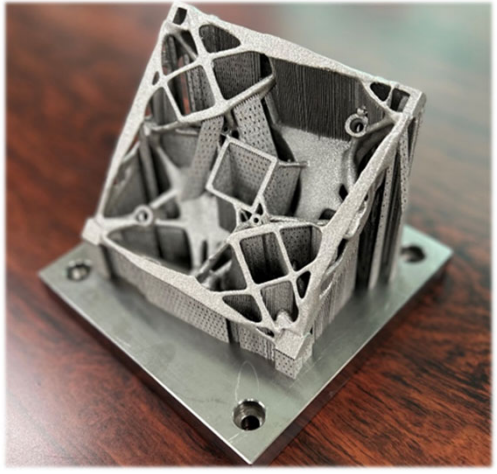


Sodick

Metal Printing Technology for Space Eng.

- **Metal printers are just beginning to make inroads in space**, although they are beginning to be employed in some ground-based systems.

- **Improving the molding strength will open the door to the future of space applications.**



Upper Panel of HEPTA-Sat

Metal 3D Printer LPM325S


Since 2012
Since 2012
Accessible to Space
with HEPTA-Sat Training!
AUTODESK UNIVERSITY

What is HEPTA-Sat Training?

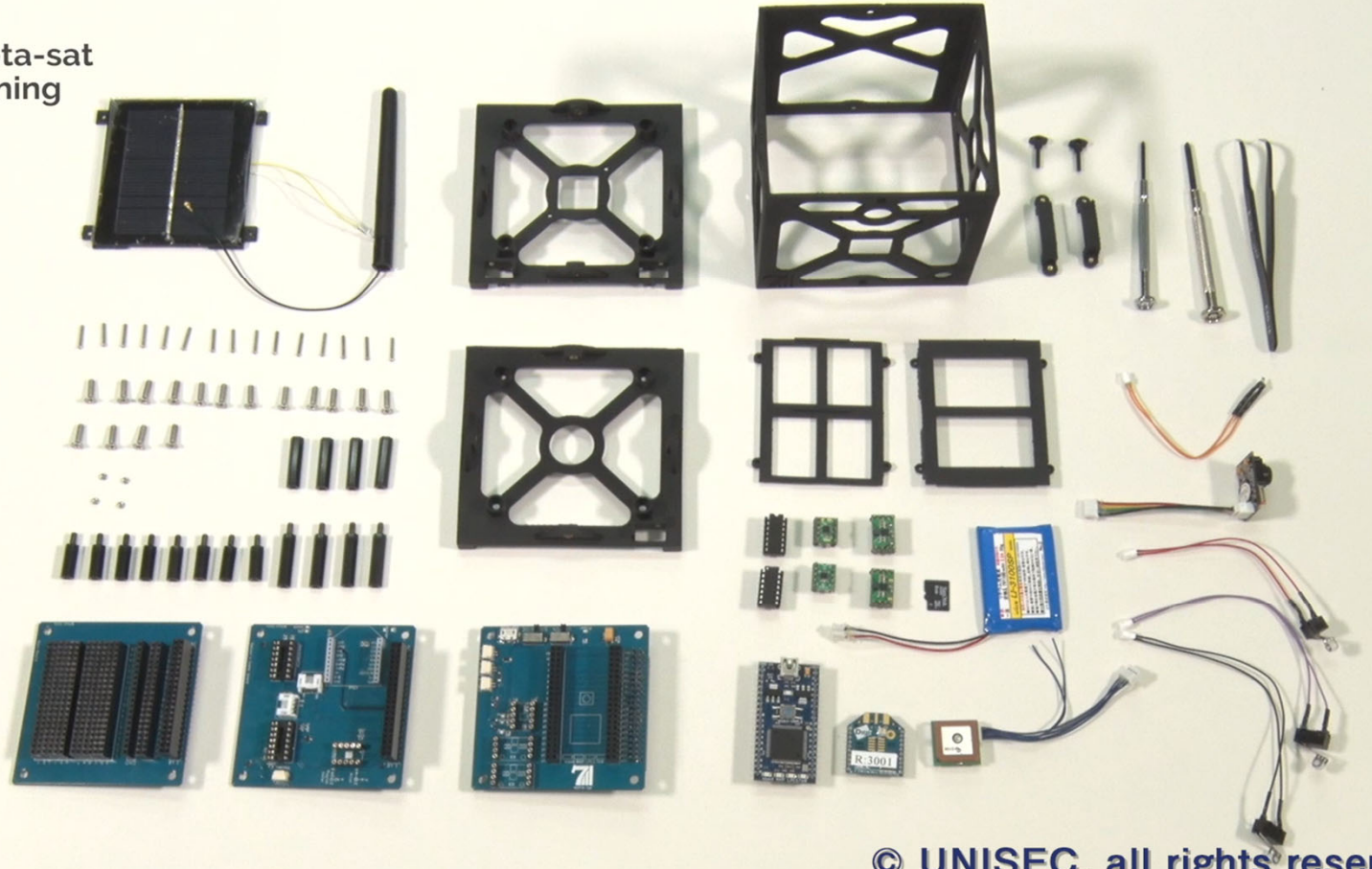
- The HEPTA-Sat Training Program was developed in 2012 to contribute to capacity building in space technology.

Annual Training Program(CLTP)

International Space University

Online Workshop(UNISEC Academy)

hepta-sat
training



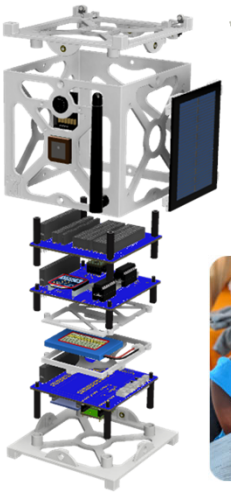

Structure Assembly

Three Steps of Training Program and more

hepta-sat training

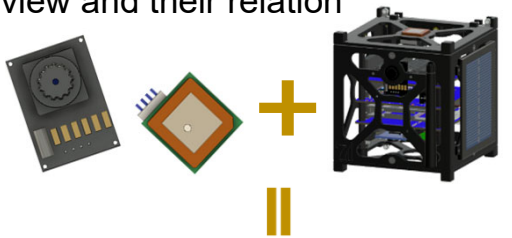
Step1 CubeSat Assembly, Integration & Test

Understand the functional and physical elements and their relationships.



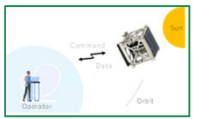
Step2 Problem & Project Based Learning

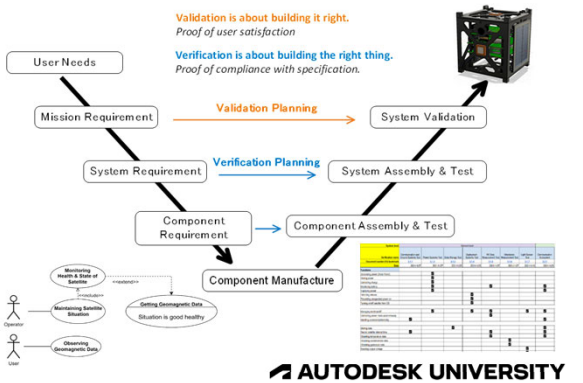
Understand the relationship between the operational, functional, and physical points of view and their relation



Step3 Visualization of design and development

Experience the development of a concurrent type development using a system model.





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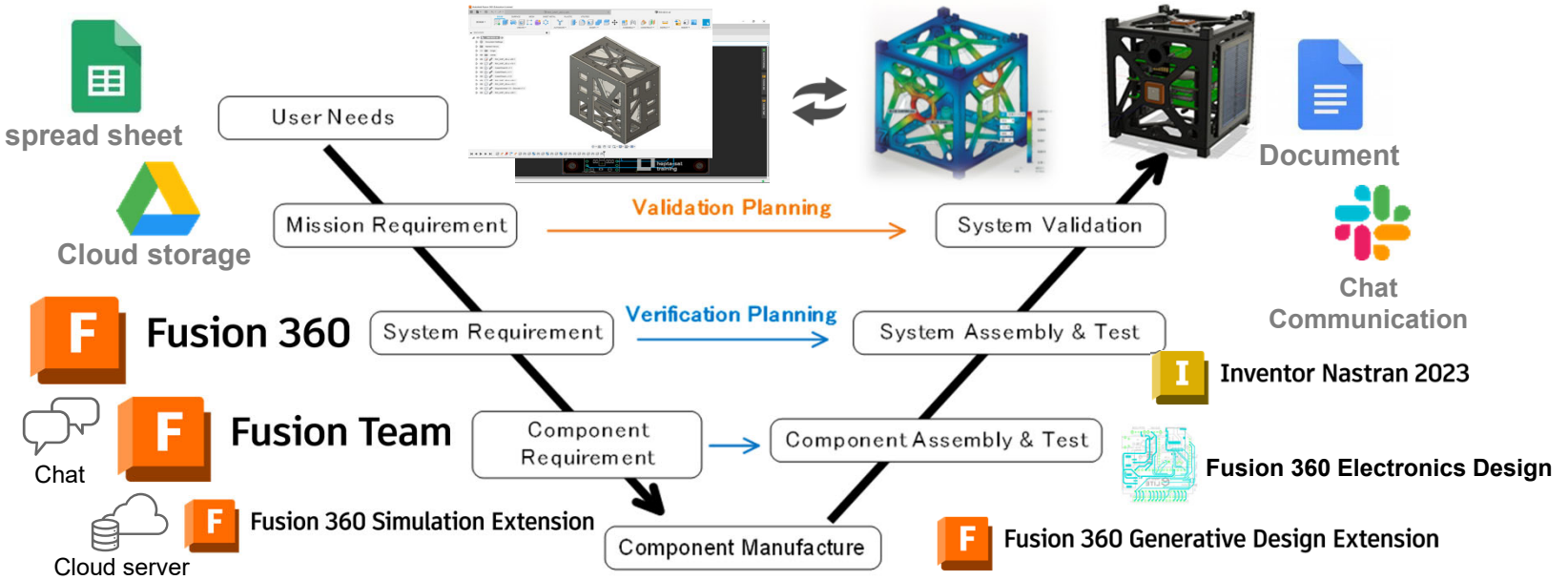
Step 4

Digital collaboration with Fusion Team

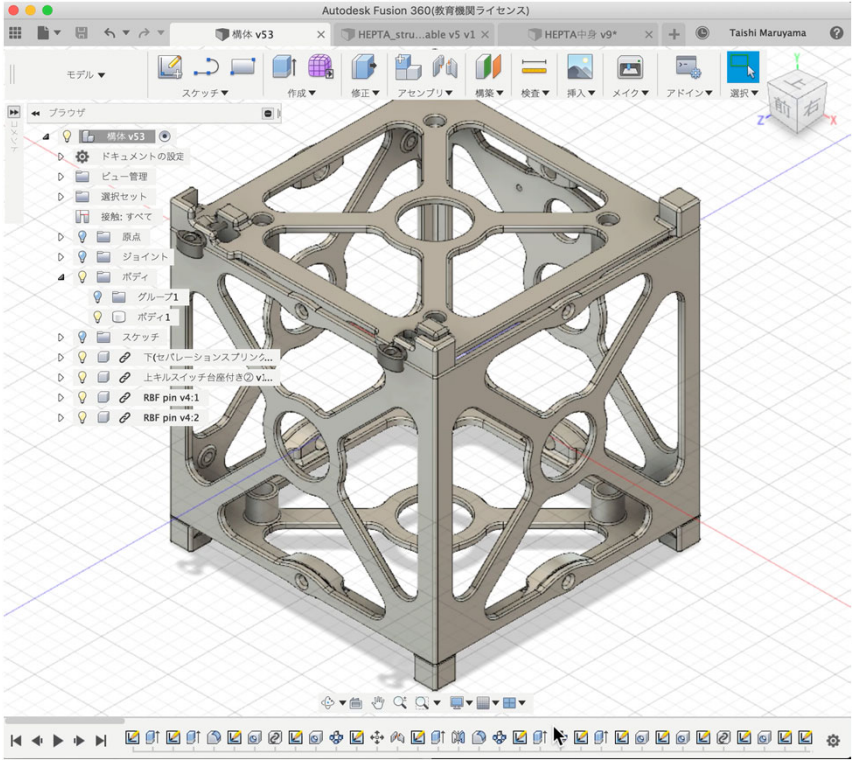
- Understand digital collaboration with the Fusion team to ensure seamless communication regarding design information sharing and development.



Carrying Over Insights Through Cloud Technology

Fusion 360's Cloud + Memo function enables researchers to pass down existing data

- **All project data is managed in the cloud**, and through **Fusion 360's memo feature** and **Fusion Team's data sharing facilitates knowledge and skill transfer**.

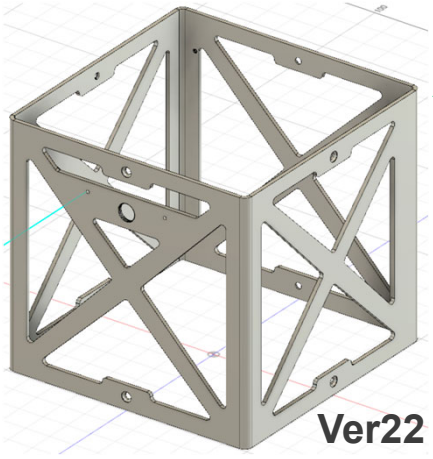


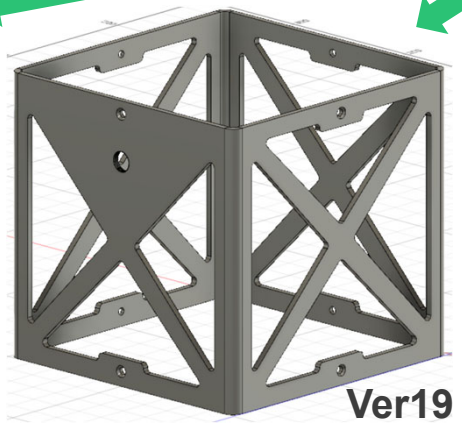
History of Development Data

Historical Edit Data is easily available!

- **Saved dates**, **who**, and their folders can be accessed and opened. It is also **possible to deal with unexpected rework**.

- It can keep not only the latest design results, but also a timeline of data from the past.

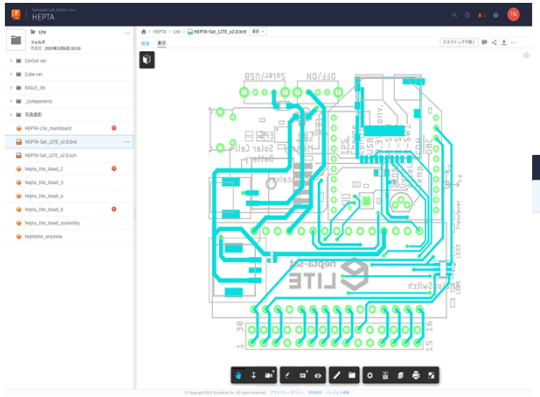


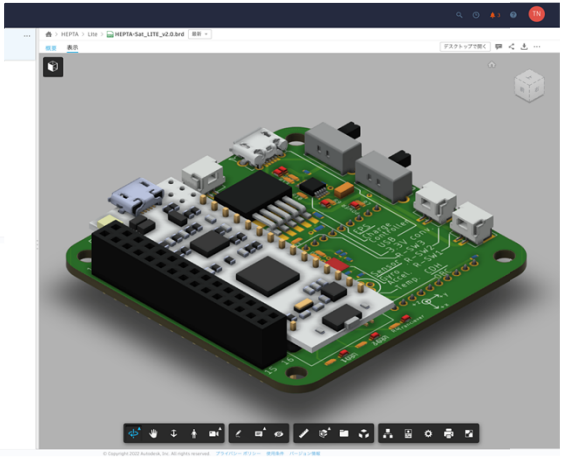


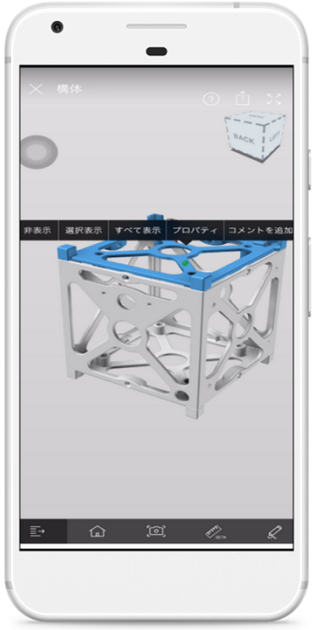
Collaboration With Electronic CAD

hepta-sat training

- Seamless collaboration through 3D data that enables collaboration with structural and electrical designers. **Data in Fusion Team** is **available on browser**. This makes it **easy to share**.







One Platform CubeSat Development

We Aim to Spread Our Cutting-Edge Research Methods Through Education

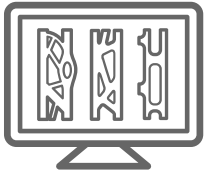
Fusion 360

Accessible

Discovering
The Space/Satellite
Development Industry **More Accessible**

Digital Collaboration

Discovering
New Forms of
Digital Collaboration
With Autodesk Products



Synergy with AI

Discovering
Unlimited Potential By
Merging AI Into Existing Technology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M325S
Let's Access
to Space together!
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