

Acrobat

Can we build in space?

Group 23

Did you know?

The International Space Station took **12 years** to build!



Earth to Orbit

22.8 tons ◀

Maximum mass to Low Earth Orbit

4.5g ◀

Forces are roughly 4½ times Earth's gravity

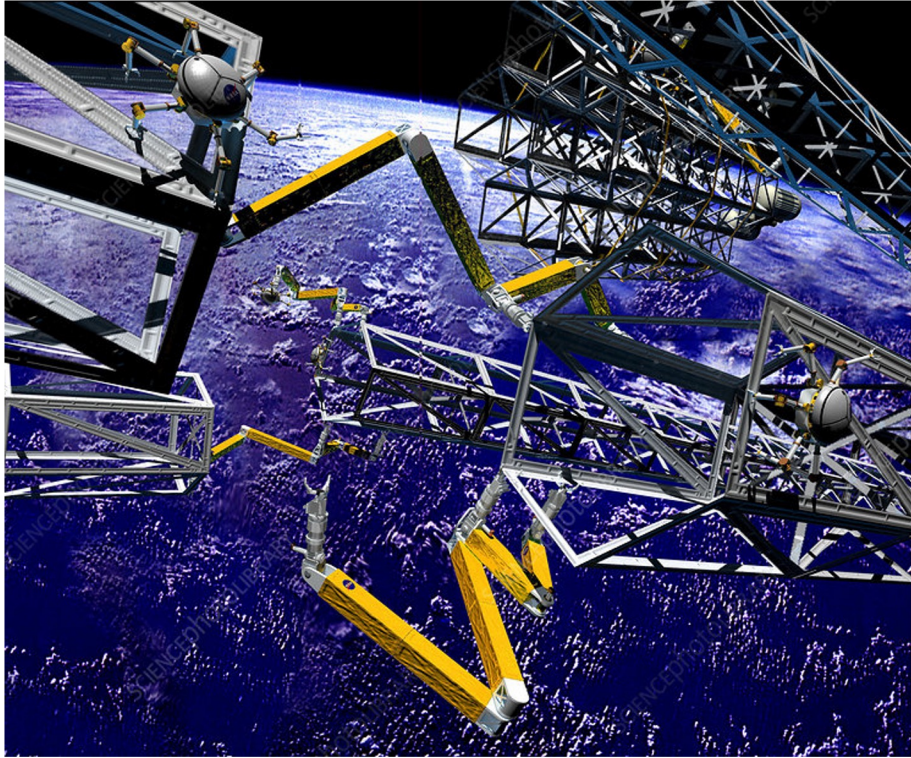


▶ **150m³**

Approximate load volume

▶ **2448€**

Cost per kilogram to orbit



Build in Space

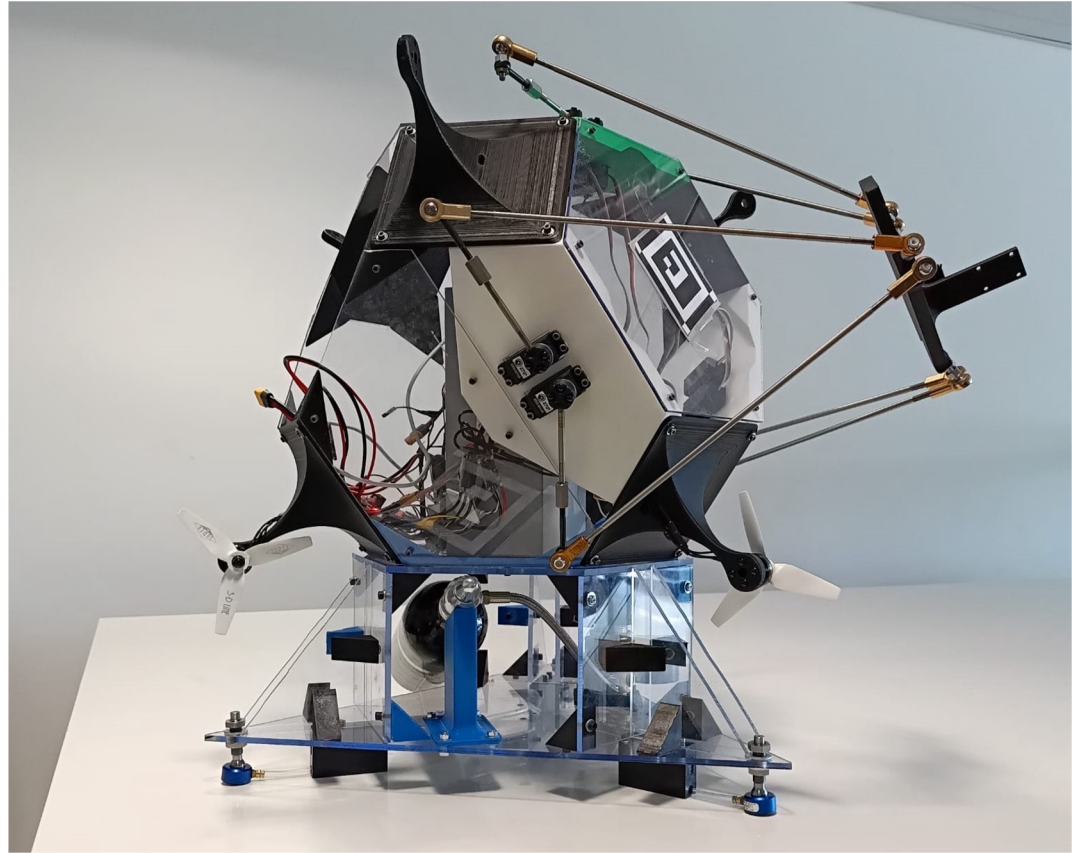
Using raw materials to build in space means not worrying about force, mass and volume constraints. We can build larger, more advanced structures for space exploration and Earth industries alike.

Meet Acrobat

Acrobat is a free-flyer robot developed in partnership with the Institute for Systems and Robotics. Its ultimate goal is to demonstrate 3D printing freely moving robot in conditions similar to space.



Dr. Rodrigo
Ventura





**A system that balances its
abilities and shortcomings is
beautiful**

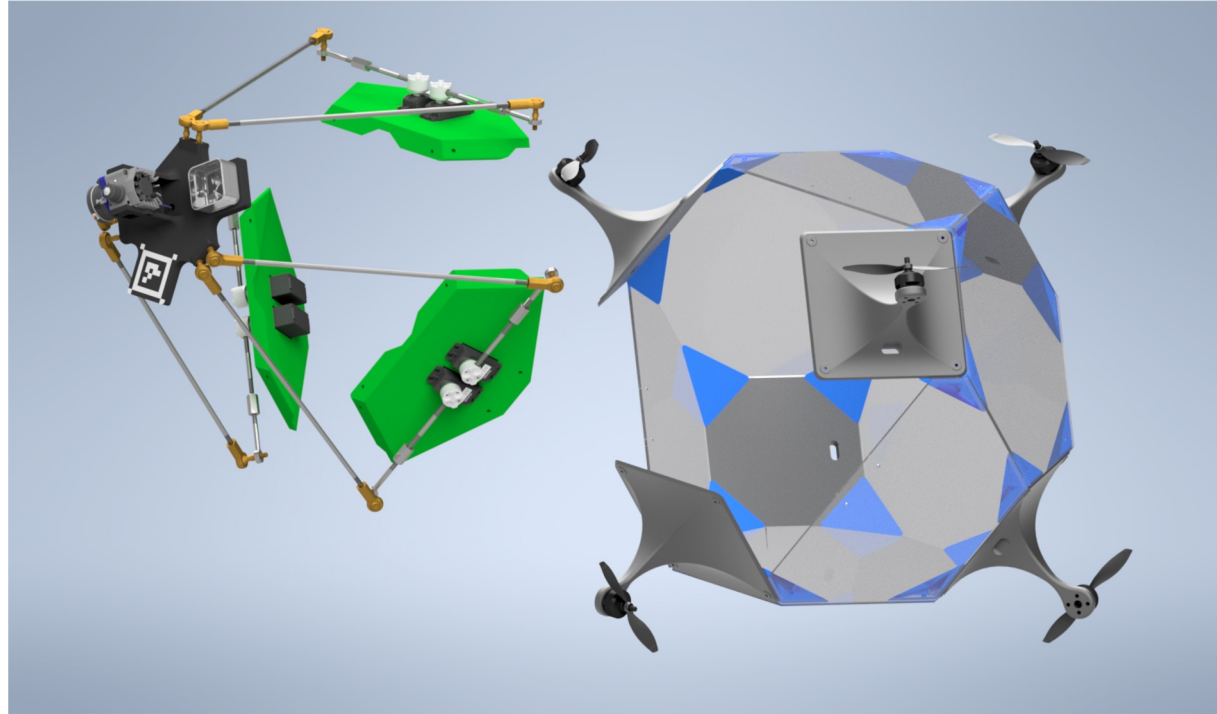
Two Systems

Body

Moves the robot slowly where it needs to go and keeps it in place while printing

Manipulator

Moves quickly and precisely to print plastic where needed

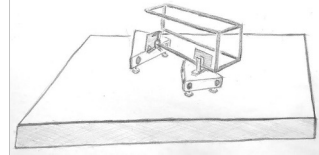


Development Plan

01

Ground Testing

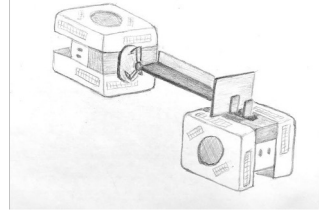
Ground demo of 2 robots producing an object on a flat table



02

Demo on the ISS

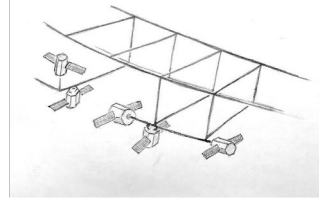
2 free-flyer robot manufacturing demonstration on the ISS



03

Low Earth Orbit

Mission using robots to manufacture an object in-orbit



Acrobat Team - LEEC



Afonso Lança

Responsible for computer vision and robotic systems modeling



David Valente

Responsible for robot software development & architecture



Inês Mesquita

Responsible for robot movement software and documentation

Acrobat Team - LEAer



Alexandre Rocha

Responsible for
mechanical design,
prototyping and printing
systems development



Lourenço Faria

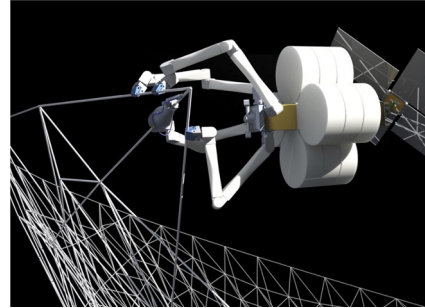
Responsible for control
system design and
body dynamics and
propeller model



Lucas Gonçalves

Responsible for
electronics and body
dynamics model

Applications



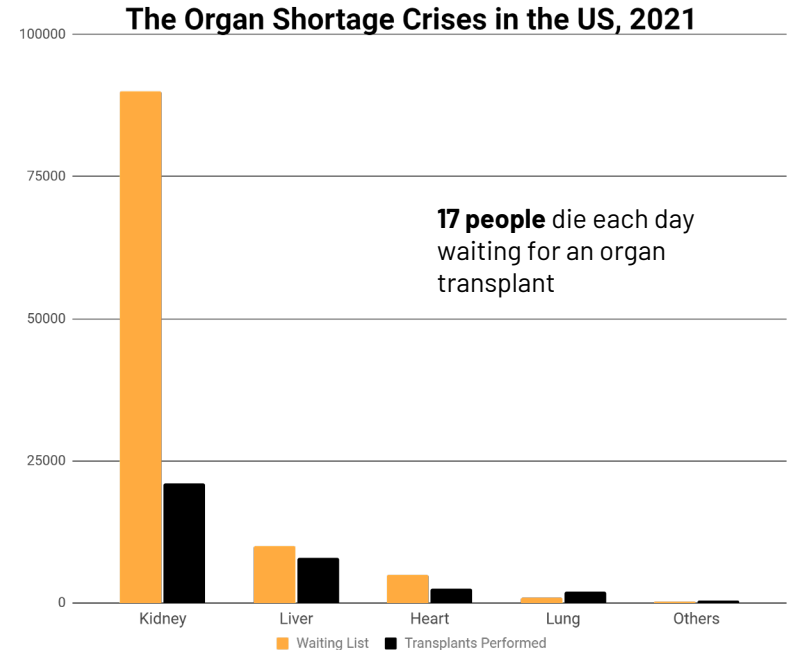
Space

Enables the construction of larger instruments, space stations and vessels to explore our solar system and beyond



Earth

Industries in 0g could solve many of Earth's problems including organ transplant shortages

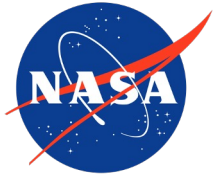


Market



Health and Pharmaceuticals

Currently worth
\$1.48 trillion



Space Industry

Currently worth
\$546 billion

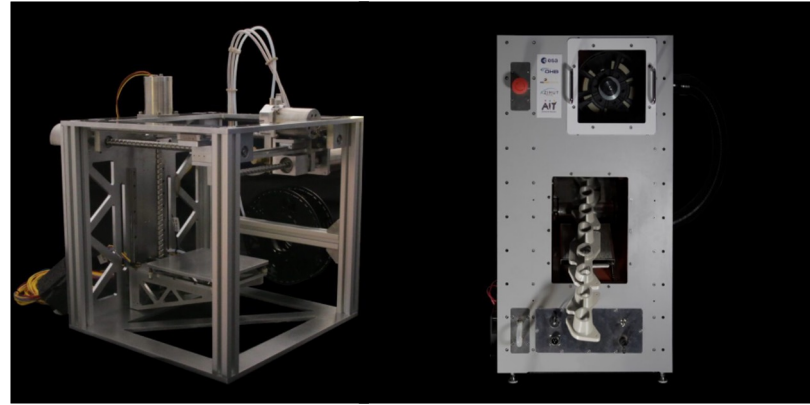


Semiconductors

Currently worth
\$544,78 billion



COMPETITORS



**MADE
IN SPACE[®]**

Them vs Us

Them

Can only print infinitely
in 1 direction at most

Can print without
restrictions in any
direction

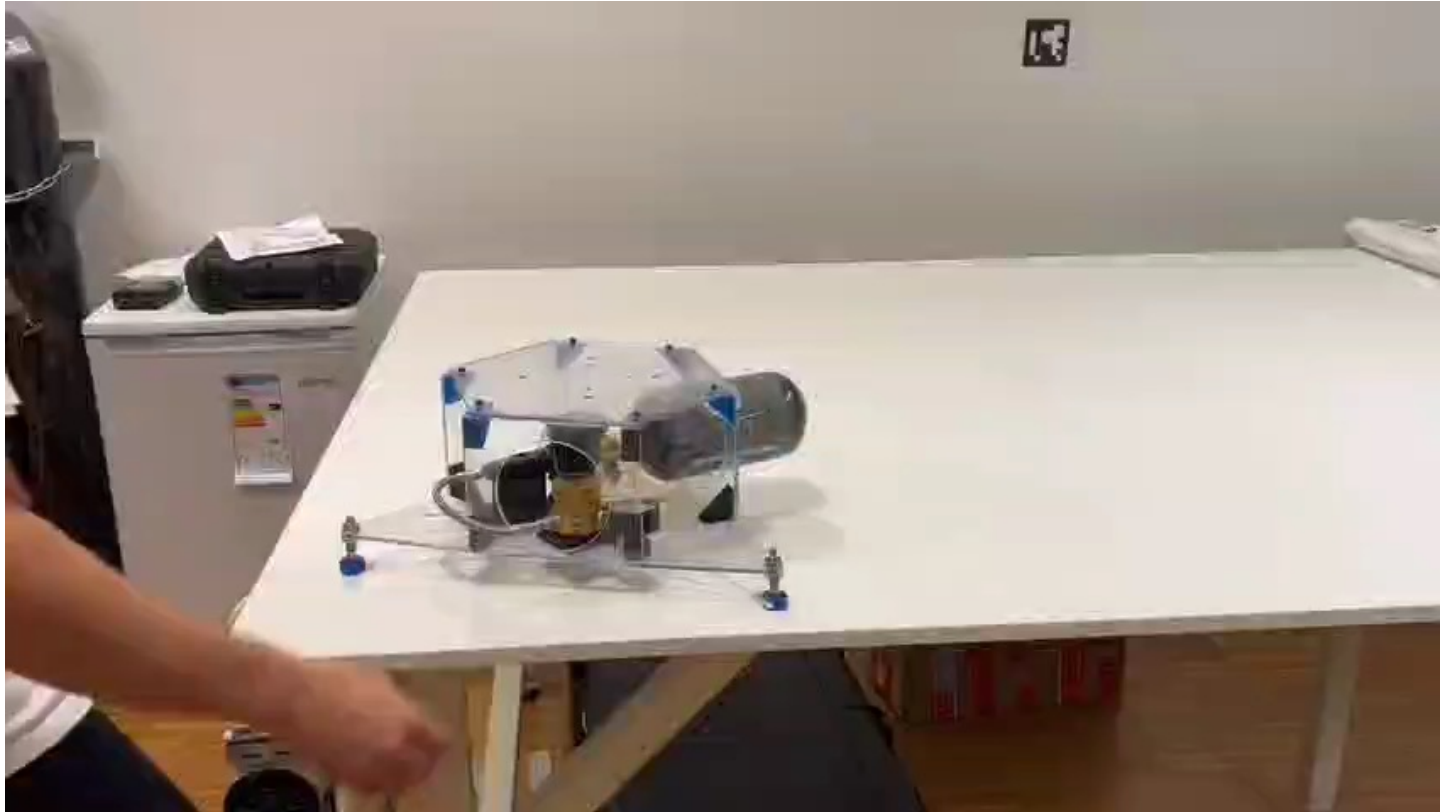
Us

Experimental Results



01

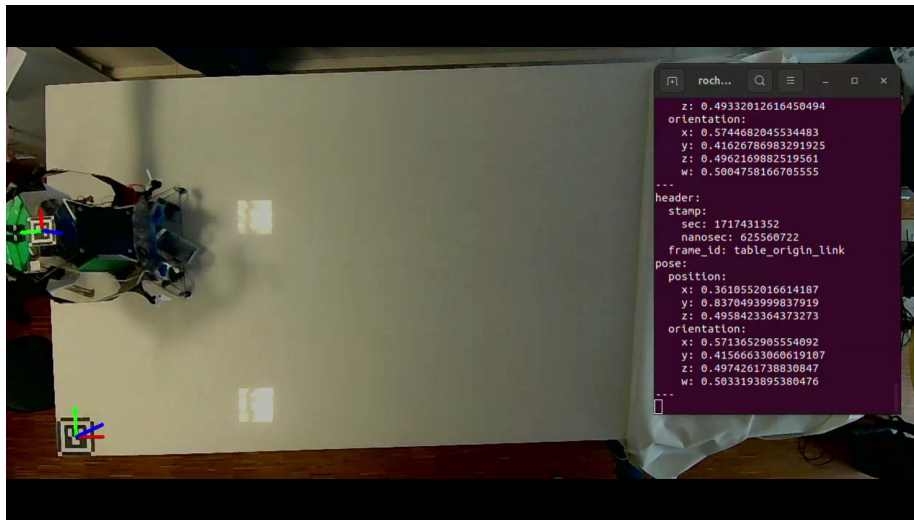
**Air Bearing
System**



Experimental Results

02

Motion



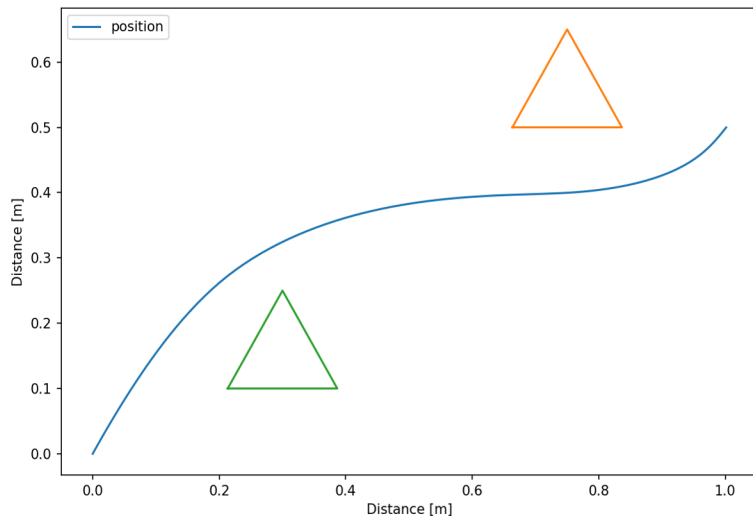
03

Vision

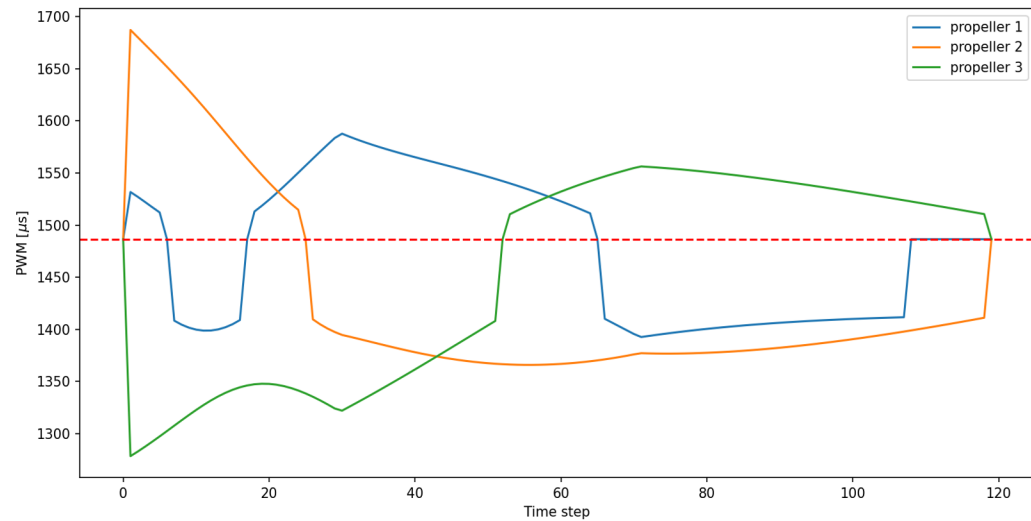
Simulation Results

03

Model Predictive Control



Path for Obstacle Avoidance



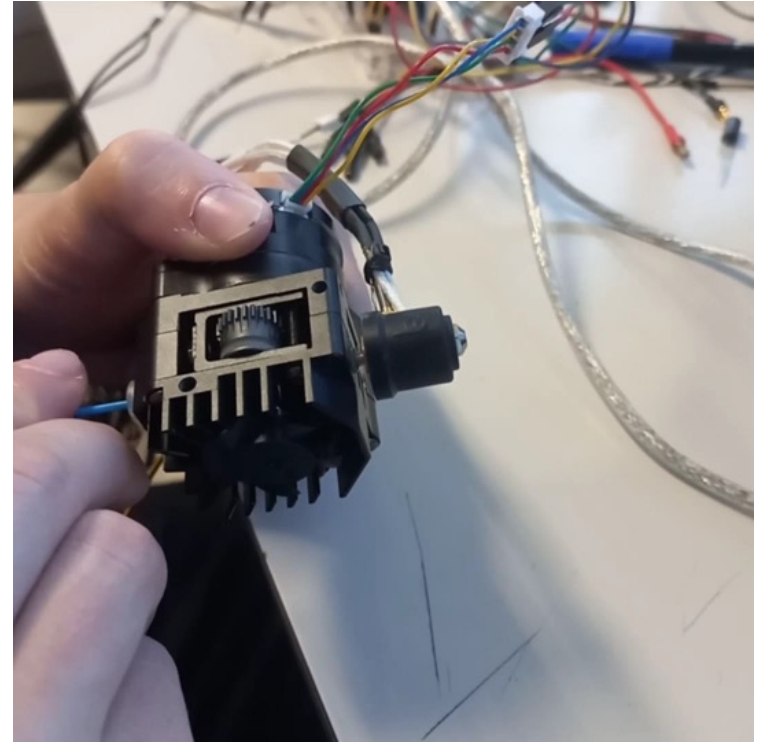
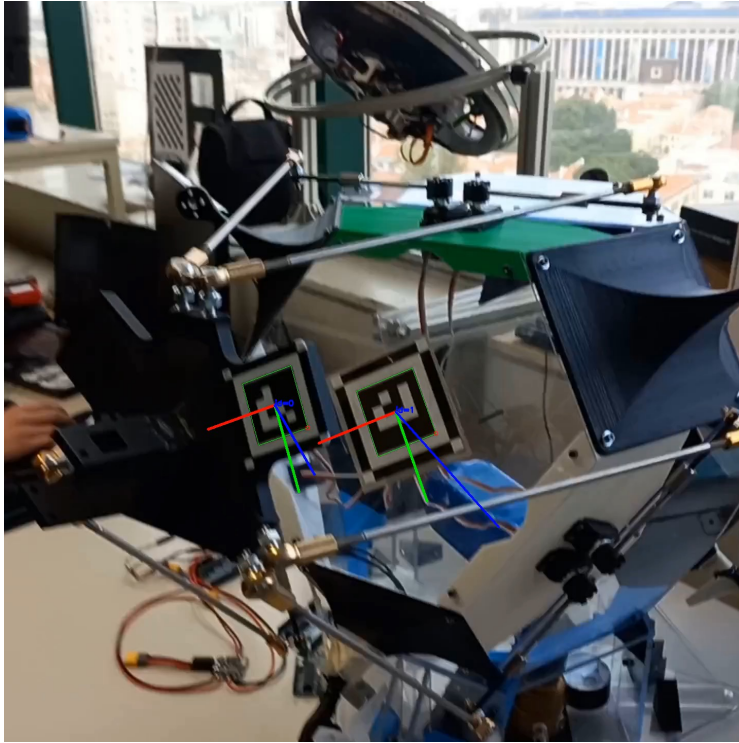
Values for Each Propeller over time steps

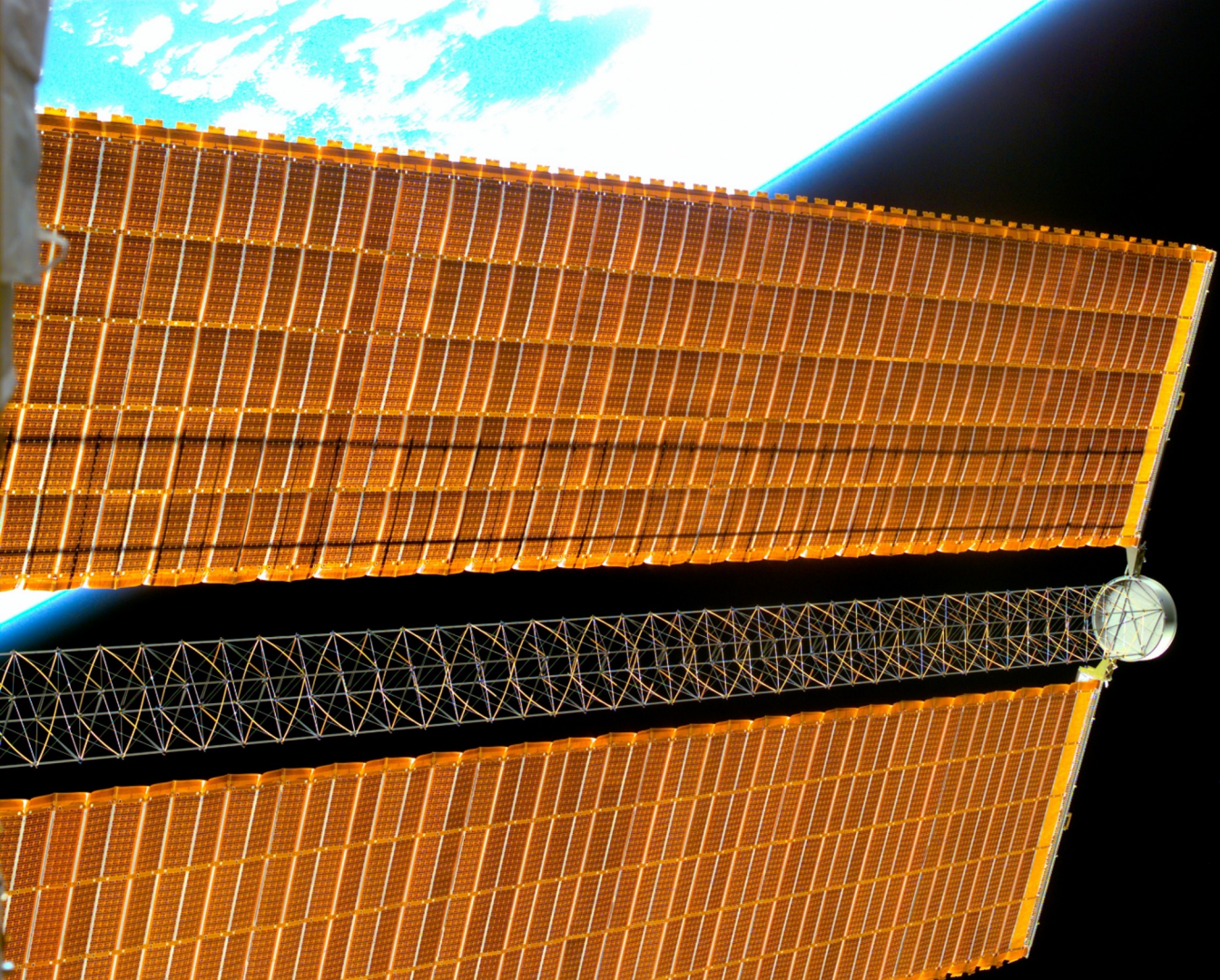
Experimental Results



05

Manipulator
and Printing
System





**Want to
know
more?**

Follow the QR Code!

