

Master thesis project: Design of a space manufacturing system for asteroid mining applications (30 credits)

Background

The space industry is changing with the advent of new companies focused on business and on advancing space technology at a rapid pace. Such is the case of space mining companies such as Planetary Resources or Asteroid Mining Corporation. In the future, we might get resources such as water, metallic iron or perovskite, harvesting them from asteroids and bringing them back to Earth.

Nowadays, some small resource harvesting platforms have already been implemented for collecting sample materials from asteroids (Japan's Hayabusa and NASA Osiris-Rex)

A limitation of these projects are the high costs incurred when launching any payload to space and extreme load cases that the payload must endure during those moments. One possible solution is self-replication, launching space probes with the capacity of harvesting material from celestial bodies and utilizing it to make copies of itself. This is a promising approach for reducing manufacturing and launch costs, as only one probe would be manufactured on Earth and launched.

The advent of novel manufacturing technologies such as 3D-printing / additive manufacturing increased the possibility to manufacture a variety of shapes and components with little to no human intervention. These technologies are one of the best candidates for developing self-replicating. However, additive manufacturing systems for in-space applications are not well developed.

Thesis questions and expected outcome

This thesis requires to develop a conceptual design of a manufacturing system able to replicate itself. This project includes:

- Requirements gathering, stakeholder identification and needs analysis.
- Function modelling of a manufacturing system for space application with identification of design constraints for such system.
- Identification of design differences between conventional manufacturing systems and self-replicating systems.
- Design for manufacturing analysis: Impact of the manufacturing technology on the geometrical design, manufacturing limitations and manufacturing opportunities.
- Conceptual design(s) proposal for a self-replicating manufacturing system

The students will be supported in their efforts by both the division of Product Development and the division of Materials and manufacturing. Moreover, the students will have the opportunity to consult with the international non-profit organization Initiative of Interstellar Studies, with vast experience on concept development for interstellar applications.

Student profile and application

The project is a good fit for space enthusiasts, eager to get involve and participate in cutting edge technology for space applications. The work is meant to be carried out by two students. Previous experience in product development projects and additive manufacturing technologies are required for at least one of the participating students. Starts in January or per agreement.

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