

Bio Satellite Sample Recovery Sub-System Design

Company: SpaceBorn United B.V. (<https://www.spacebornunited.com>)

Project open to: Final year undergraduate, Masters students

Application closing date: 20th June 2021

Expected duration of project: 6 months (longer if part time)

Latest start date: October 2021

Application link: <https://forms.gle/Yr6wzKw3kAVZ27Vz9>

Organisation description

SpaceBorn United is a Netherlands based start-up that researches and aims to enable human reproduction in space. Our three main activities are: 1. researching the conditions for human reproduction in space; 2. translating the outcomes into mission designs and a missions program; 3. Developing the assisted reproductive technology required during these missions. SpaceBorn United contributes to humankind becoming a multi-planetary species. Our growing international team is enabling reproduction in space to make existing plans for independent human settlements beyond Earth sustainable.

We are currently focussing on conception and early embryo development in low earth orbit. During the last 3 years, this involved supervising 14 MSc graduation research projects from Universities in the UK, The Netherlands and Germany.

Project description

The technology we develop for conception and embryo development in space is called ARTIS (Assisted Reproductive Technology In Space). For this ARTIS mission we are finalising the payload design and the mission architecture. This mission uses an independent recoverable biosatellite that returns the cell samples after a 6 day mission in low earth orbit. We are re-engineering existing IVF technology (an embryo incubator) for application in space. This biomedical payload serves as a life support system in which human reproductive cells can be fertilized and develop into embryos. After 5 days we protect the embryos for the re-entry stage by pausing their development via cryogenic freezing. This research and design project focuses on exploring feasible sample recovery approaches with an appropriate re-entry-device (RED). The design solutions need to be aligned and integrated with the biosatellite and payload design.

Previous studies have resulted in a baseline mission and payload architecture and design for performing automated in vitro fertilisation (IVF) and early embryo development in LEO and returning the resultant embryos safely to Earth. The baseline mission uses either Virgin

Read the SpaceProjects.uk scheme handbook

<https://spaceprojectsuk.files.wordpress.com/2021/03/spaceprojects.uk-handbook-1.pdf>

Galactic's Launcher One or Dawn Aerospace's MK-III uncrewed spacecraft. Given the existing small-satellite based baseline ARTIS mission and the need to recover biological embryo samples to Earth, a sub-system for safe sample recovery from LEO is one of the major mission design drivers. The overall aim of the project is to produce and justify a preliminary design solution for a sample recovery sub-system for the ARTIS mission. The project objectives are:

1. Consolidate, clarify and expand as necessary existing design requirements within the context of the existing ARTIS baseline
2. Review existing relevant technologies and related spacecraft relevant design solutions
3. Propose and where appropriate model design solutions
4. Select a preferred design solution
5. Refine design solution description and where appropriate modelling of the design

This project will start with meeting the relevant members of our team and external industry partners so you can understand the scope, dimensions, requirements and constraints of the project and design solutions. As you move through the key stages of the project (research, trade-off, design) there will be many opportunities to present your findings to get feedback and learn about real space engineering. At the end of the program you will present your final design, as well as your conclusions & recommendations on how the design could be taken forward.

Person specification

We are looking for students who are comfortable running a research and design project mostly individually. Subject matter experts from SpaceBorn United and our industry partners will provide feedback at key points throughout the project, but the day to day activities will be set by you. We are looking for people who are naturally passionate and curious to learn the lessons of previous designers, but are able to challenge assumptions about how design challenges should be approached or solved.

We expect someone studying an aerospace degree would be best suited, but we are open to other related backgrounds as well. An interest and/ or any previous experience that includes bio-satellites / bio sample recovery / re-entry device technology is desirable and could make the task easier to tackle. Subject specific information regarding life support systems, IVF, assisted reproductive technology or embryo development is not expected from the student. Any key topics will be explained with personal support throughout the project.