

Leverhulme Doctoral Scholarships Programme for Interdisciplinary Resilience Studies (PIRS) University of Southampton

RECRUITMENT CYCLE for studentships starting: October 2024

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STUDENTSHIP PROJECT TITLE

Outer space resilience

OVERVIEW

Outer Space provides critical socioeconomic benefit and irreplaceable cultural value but is under threat from exponentially growing satellite and space debris populations. This project focuses on the cultural evaluation and measuring of space sustainability and such detailed aspects as the technically central term of “orbital carrying capacity”.

SUMMARY

The space object population is reaching a tipping point, putting at risk our fundamental socioeconomic systems (Interconnected Disaster Risks, 2023) and degrading the quality of our shared night sky. As the space object population approaches this critical threshold, vital systems and infrastructures will become fragile, and astronomical observations, cultural experiences and practices dependent on dark and quiet skies will be damaged, unless resilience can be restored. Addressing these issues requires a truly interdisciplinary approach, merging humanities, social sciences, physical sciences, and engineering to realise sustainable use and exploration of outer space.

This project focuses on the cultural evaluation of space sustainability and such detailed aspects as the technically central term of “orbital carrying capacity”. Ostensibly, orbital carrying capacity is a simple index used to portray space sustainability. As such, it has value for policymakers and regulators who wish to simplify their processes and base them upon an objective and consistent measure of humanity’s use and exploration of outer space. However, current approaches for measuring orbital carrying capacity marginalise or even neglect cultural perspectives and the impacts of outer space activities on ecological systems. This is particularly apparent in the context of dark skies. Hence, this project will aim to deliver a solution arising from studies of resilience with technical and cultural perspectives, developing a broader interdisciplinary approach in which the scientific and engineering concerns of space sustainability can be addressed.

Research Groups involved:

Astronautics Research Group, Faculty of Engineering and Physical Sciences
(<https://www.southampton.ac.uk/study/subjects/aeronautical-astronautical-engineering>)

Southampton Institute for Arts and Humanities
(<https://www.southampton.ac.uk/research/institutes-centres/southampton-institute-for-arts-humanities>)

PROJECT CONCEPT

The number of satellites and space debris is reaching a tipping point, putting at risk our fundamental socioeconomic systems (Interconnected Disaster Risks, 2023) and degrading the quality of our shared night sky. As the space object population approaches this critical threshold, vital systems and infrastructures will become fragile, and astronomical observations, cultural experiences and practices, and ecological systems dependent on dark and quiet skies will be damaged, unless resilience can be restored. Addressing these issues requires a truly interdisciplinary approach, merging humanities, social sciences, physical sciences, and engineering to realise sustainable use and exploration of outer space.

State-of-the-art approaches addressing these concerns have emerged recently. These use simple indices and measures to depict and communicate

space sustainability and orbital carrying capacity. They are intended ultimately to simplify policymaking and regulation of outer space but depend almost exclusively on physical characteristics of orbital objects and of the space environment, neglecting the fundamental socioeconomic, cultural, ethical, and human values attached to sustainable use and exploration of outer space. Here for example indigenous contexts of understanding the night sky become prevalent and often marginalised sets of approaches. The value of dark and quiet skies has been recently lifted as a central part of a broader aesthetic and ethical evaluation of space (as viewed from earth) and should be integrated into a more holistic cultural approach. This is in addition to the importance of dark skies to human well-being and that of various flora and fauna.

This project aims to develop an approach that focuses on questions of resilience from such a cultural perspective, developing a broader interdisciplinary angle to contextualising scientific and engineering concerns of space sustainability with their broader repercussions. In its simplest form, the approach views outer space as an environment supporting a community function. This function could be the provision of safe satellite operations or undisturbed sky viewing. Resilience provides a mechanism for understanding, measuring, and communicating the fragility of this function through the “resilience triangle” (Figure 1, Buckalew et al., 2019). Shocks to the outer space environment, such as accidental or deliberate collisions, or even space weather events may degrade the community function. These shocks and events can be simulated, enabling the depth of the change and the time taken to restore the previous functional level – the resilience triangle – to be measured. Hence, offering a simple and effective mechanism for understanding the fragility (i.e., resilience) of outer space for a multitude of different uses and users.

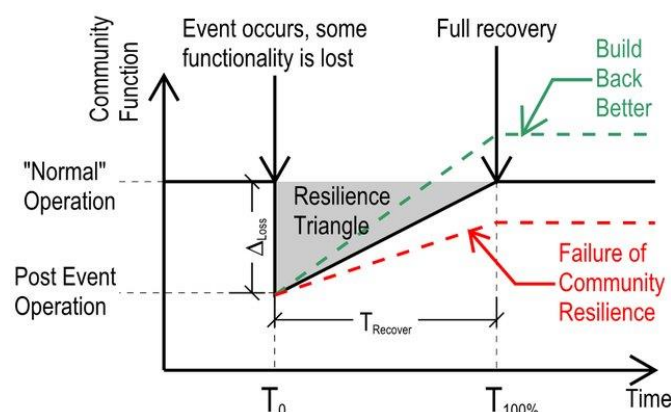


Figure 1. Schematic of the Resilience Triangle, comparing community function over time following an event (Buckalew et al., 2019).

The objectives of the project will be:

- To review the status of the space environment and its governance.
- To develop a cultural understanding of “orbital carrying capacity”.

- To identify the multiplicity of ways in which we explore and use outer space, and the key stakeholders.
- To evaluate state-of-the-art approaches for measuring and communicating space safety and sustainability to different stakeholders.
- To understand the role of and develop a method for use of resilience within the governance of outer space.
- To develop effective communication routes and methods, centred on resilience.

Engagement with a diverse set of stakeholders, including astronomers, satellite operators, Indigenous Peoples, policymakers, and regulators will be an important part of the project. The supervisory team, through their work across different institutions, committees, and organisations, will actively support this engagement.

Ultimately, the outcomes of the project are expected to have benefits to the UK government, as it seeks to lead international efforts towards space sustainability (<https://www.gov.uk/government/case-studies/space-sustainability>) and the space sector in the UK, where guidance is urgently needed to enable the UK's ambitious sustainability targets to be met. Additionally, the outcomes will feed into ongoing discussions at the United Nations and the Inter-Agency Space Debris Coordination Committee (IADC) on space sustainability. Within the timeframe of the PhD project, for example, the IADC will be developing new ways to understand and measure the status of the space environment, with the expectation that these will subsequently feature within the standards, policies, and regulations of individual States.

Contribution to interdisciplinary resilience studies:

A cultural and critical framing of resilience has emerged over the past years in cultural and media studies and the humanities. In this project, we contextualise “resilience” as part of the broader question of sustainability and critical infrastructure, represented here by Outer Space technologies as well as their cultural import, including cultural heritage of dark and quiet skies. The different value systems and stakeholder communities invested in this perspective can specifically enable us to understand such subtle aspects of cultural resilience while contributing to the emergence of a new field around space sustainability, especially in this interdisciplinary focus. The project team's experience in Astronautics, critical media and infrastructure studies, as well as critical curatorial and practice-led art methods helps to frame space sustainability in such a view that comprehends aesthetic and ethical issues. Overall, our proposed project can help also to expand existing Resilience Studies with the critical cultural angles, e.g. Decolonial or other aspects relevant to the case.

Please list and describe any specific/additional technical training or support to undertake and successfully deliver this project. Note that students recruited into this programme will undertake a bespoke training curriculum. Students and their supervisory teams will also identify generic skills gaps to address through training courses offered by the University's Doctoral College.

Training related to space debris, space safety, and space sustainability will be provided by the supervisory team, including (as needed) support for the development of computational models and simulation tools.
