

ISSF Graduate Student Fellowship Program

Guidelines and Suggested Topics

Space safety is concerned with the design, testing and operations of space systems and the associated safety risks imposed on:

Individuals: Exposure of citizens and spaceflight crews/participants (flight & ground) to risks constituted by spaceflight activities

Society: Interference with current (inter-/national) activities on Earth, in airspace and Earth orbit

Globe: Impact on the environment (Earth & Space) from spaceflight activities

Proposals for safety must fall into one of the five categories:

Launch and Reentry Safety

Launch and Reentry Safety addresses international methods and policies for providing public safety during launch and re-entry. Support to the creation of safety guidelines for the international space launch industry based on consensus on standards and methods concerned with launch safety. Documentation of assessment techniques and technical proposals for reducing hazards emanating from man-made space debris and the re-entry into the atmosphere of space hardware and materials.

Proposed Topics:

There exists a number of standards for acceptable risk to the public for launch phase risk acceptance, and almost none for re-entry risks. There are numerous underlying open questions which should be considered.

1. How safe is safe enough? By what logic should this question be answered?
2. By what measure should risk be calculated? Some Nations use maximum individual Risk of fatality some use risk of casualty (serious injury). Some use expected total fatality or casualty.
3. If a certain level of risk is acceptable for one nation to accept the launch risk should that same level of risk apply to an adjacent country that is also exposed to overflight risk during launch?
4. Re-entry risks are often spread over very large segments of the globe covering multiple countries. By what logic should re-entry risks be managed, given the lack of control of re-entry location?
5. Should the risk of re-entry and the risk of launch have independent risk budgets (or allocations)?

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Space Hazards

Space Hazards focuses hazard from both manmade and natural space debris. Mitigating orbital space debris, predicting the hazard to manned and unmanned space and launch systems posed by space debris, future efforts and proposals for reducing this hazard both on-orbit and upon reentry are relevant. Understanding and mitigating space-related natural disasters caused by impacts of asteroids and comets via regional and global level response is a key area of interest. Mitigation activities may span identification, warning, active & passive response, and recovery.

Proposed Topics:

- Quantification of risks spanning manmade orbital debris and near Earth objects (NEO) to cover both probability and consequence explicitly.
- In situ active response modes for NEO deflection and destruction missions
- Orbital debris remediation mission optimization of costs, reduction in risk, and reliability of mission

Commercial Human Spaceflight Safety

The Commercial Human Spaceflight Safety addresses how standards, practices, methods, and designs promote or impede safety of commercial human space flight operations. This includes evaluation of system safety standards, guidelines and practices for the safe design and operation of space vehicles with respect to orbital and suborbital (commercial) human spaceflight, the safety of, and hazards posed to, humans while interacting and interfacing with autonomous and remotely controlled robotic systems and space nuclear systems. Additional assessment of the need for, and support to, the definition of consensus policies, guidelines & standards for commercial human spaceflight is assessed.

Proposed Topics:

- Acceptable Levels of safety for Commercial Human Spaceflight. This would apply for Orbital as the IAASS has guidelines for suborbital flight. This needs to consider what would be an acceptable risk level for commercial passengers/customers. NASA has set a requirement for the acceptable level for Loss of Crew/Loss of Vehicle. The 1100 series requirements establish 1 in 270 for a 210 day mission and 1 in 1000 per mission for launch/re-entry. It is noted that potential commercial crew partners are struggling to meet these basic requirements. A future system for a mission to a Bigelow Space Hotel for a 10 day stay, for example, would have similar struggles.
- Review of NASA Commercial Human Spaceflight (CHS) Standards (1100 series); rationale is that Space-X started designing/manufacturing the Dragon vehicle prior to the

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introduction of the 1100 series and hence have 'waivers'. Are these waivers justified for the Space-X design or simply necessary in practice

- Review of FAA-AST Recommended_Practices_for_HSF_Occupant_Safety-Version_1-TC14-0037; Are these practices too focused on US concerns? Would an unbiased review that takes into consideration modern 'best practices'?
- Main Considerations in Designing New Space Stations for Commercial Use; rationale is to provide a modern streamlined and safe methodology of functional, performance and safety requirements. A review should assess the ISS approach and perhaps lessons learned to improve future such space stations.
- Space Rescue/Recovery from A Bigelow Style Space Hotel or International Space Station. A rescue mission may not be feasible to address an on-orbit emergency, hence an alternate plan should be in place should the need arise.

Human Factors and Performance

Human Factors and Performance for Safety focuses on strategies for optimizing human performance and minimizing errors by increasing awareness of human factors engineering best practices throughout the entire lifecycle of spaceflight programs. The TC studies and assesses human factors best practices for spaceflight crews and ground personnel, identifying vulnerabilities, improving organizational safety culture, etc.

Proposed Topics:

- Identification of human factors and performance issues and best practices relevant to commercial space operations (e.g., physiological, workload/scheduling, flight-ground communication/coordination)
- Human factors and performance lessons learned from other safety critical operations (e.g., high risk work domains, operations in extreme environments)
- Strategies for evaluating and implementing human-centered design principles for flight deck and console design for both flight crew and ground personnel

Space Safety Laws and Regulations

Space Safety Laws and Regulations consider the current status and need for improvements in national, regional and international space safety laws, agreements, regulations and practices including frequency allocations, interference and jamming, space debris and cosmic hazards, space traffic management and control, safety standards, especially concerning human spaceflight for governmental, military and commercial flights, nuclear energy and dangerous chemicals and toxic materials in space, and other relevant areas including new space commercial applications. It reviews the application of existing international treaties,

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agreements, conventions, standards, codes of conduct, or transparency and confidence building measures that relate to space safety issues in order to consider their current effectiveness, proper interpretation, and possible improvement to strengthen space safety governance and global space safety practices.

Proposed Topics:

- Development of international , national, and/or regional standards and "soft law" mechanisms and codes of conduct to minimize or reduce space debris
- Undertake systematic review of Chicago Convention of 1944 and existing international law and regulations that could enable future conduct of space traffic management and control
- Conduct legal analysis of the current international regulatory authority for international operations in the so-called "Protozone" (i.e. the area above commercial air space 21 Km and below satellite orbital altitudes or 250 Km) and whether analogies to Law of the Sea might assist in such considerations.
- Analysis of components of law, regulations, standards or codes of conduct that might be applied to military or defense-related uses of outer space