

Part 1: SABBATICAL PLAN

Board of Regents and CU System policies require the following information be provided by each faculty member applying for a sabbatical assignment. Thank you for completing this public document in a clear and substantive way. Each response should be a minimum of 300 words.

Applicant Name: [REDACTED]

Title of Sabbatical Project: Design, manufacturing and deployment of ultra-large space structures

(1) Describe your sabbatical's academic objectives including its contribution to your professional growth and expertise.

This project aims to extend my previous research in deployable and lightweight space structures to the case of ultra-large space structures, defined as those with dimensions in the order of tens of meters or longer. While there are structures with those dimensions currently in space, the International Space Station being the most obvious example, it is still a relatively unexplored corner of the aerospace industry, particularly for the case of very lightweight structures (e.g., very large antennas or other communication systems). Future scientific and technological advances not only require the design, manufacturing, and deployment of structures of this size, but also to do so in a sustainable way. This includes leveraging opportunities to build and assemble structures in-space, repurpose structures after the end of their mission, and in-space recycle the materials used. In this project I am not limiting the scope to in-orbit structures but also considering the possibility of structures being built or deployed on other planets, such as infrastructure supporting manned or un-manned lunar missions. The project will be articulated around two different yet closely related thrusts.

The first thrust of this project focuses on exploring different materials, architectures, and processing techniques that will not only enable novel ultra-large and lightweight aerospace structures, but also their sustainability. This includes not only reducing the amount of material used but also employing materials and processes that enable in-situ manufacturing and recycling. As an example, traditional composites are a combination of high-performance fibers, such as carbon, with a thermoset matrix, a polymer that is cured to achieve rigidity. Repairing, recycling or repurposing these structures is challenging due to the nature of the matrix, and so they are often discarded after their failure, or chopped to pieces and used as filler after the end of their intended life. I will explore the alternative of using a thermoplastic matrix to bond the fibers instead. These polymers can be re-heated and reshaped repeatedly, but their use in fiber composites has been very limited, so there is little information on how these properties could be used to reshape a fiber-reinforced thermoplastic, and how this would affect the integrity and distribution of the fibers. If viable, this process could be used to recycle composite laminates in space, or to reshape composite structures on a Moon base (e.g., turning elements from a vehicle into lunar infrastructure).

The second thrust of this project focuses on the specific challenges associated with space structures larger than tens of meters. My previous research has produced estimations and experimentally characterized the natural frequency and buckling loads of lightweight space structures, from hinged panels in the centimeter scale to deployable booms in the meter range. This work has often been performed in collaboration with researchers at the Jet Propulsion Laboratory (JPL) or the local aerospace industry, with the goal of providing practical design guidelines. However, there are several aspects of the mechanics of lightweight space structures that scale unfavorably with the size of the structure. For example, torsional vibrational and buckling modes are not critical for small structures but might take dominance as they grow very

large. Understanding the scalings controlling the behavior of structures in that size range will be essential for their design. Additionally, the natural frequency of these structures is expected to be significantly lower than current industry standards (likely in the millihertz range or lower), which will require novel approaches to limit the danger of resonance and other interactions between spacecraft orbital dynamics and the vibration of the structures.

Successful implementation of this sabbatical project will help me open new research avenues that, extending previous results from my research group, address important engineering challenges that will be relevant to the aerospace industry for several years. Furthermore, it has the potential to transform my research and inform my teaching and mentoring at both the undergraduate and graduate level.

(2) Describe your work plan including all anticipated professional activities (i.e., where will you spend your sabbatical, what you will do, your work timeline, etc.).

To accomplish the goals described before, I intend to take a full academic year sabbatical (AY25/26) during which I will spend most of my time at the University of Colorado Boulder, working with my research groups and existing local collaborators. In addition, to reinforce existing external research collaborations, expand my network with new ones, and build new research opportunities, I am actively coordinating visits to several research institutions, including US and international universities, as well as federal research labs.

Regarding US institutions, I plan to visit the NASA Jet Propulsion Laboratory (JPL) [REDACTED] experts in the design and manufacturing of spacecraft structures and co-principal investigators in a now finished joint project. I also aim to visit the Air Force Research Lab in Albuquerque, New Mexico to extend previous work on deployable structures with [REDACTED] while maintaining their jobs at Air Force Research Laboratory (AFRL) / Space Force. I will also aim to visit Purdue University, [REDACTED], who is an expert in the time dependent behavior and viscoelasticity of composite materials, particularly for space structures.

Regarding international institutions, I aim to arrange two different research stays. The first one [REDACTED] who studies biological structures that could be used to as inspiration to design space structures, such as the inflation and deployment of the wings of the drosophila. Bio-inspiration is often used in other areas of structural mechanics, but it has rarely been applied to space structures. The second [REDACTED] in the design of space structures, ranging from antennas to deployable decelerators in the hypersonic regime, which is a particularly active research topic in the [REDACTED]. Furthermore, I aim to travel to visit former advisors and collaborators in Switzerland [REDACTED] and Spain [REDACTED] to give seminars and promote CU Boulder for future student recruitment.

(3) Describe how meeting your sabbatical objectives will benefit the academic, clinical, and/or pedagogical goals of your primary unit.

The focus of the proposed project is directly aligned not only with my personal research, but also more importantly with the broad research goals of the [REDACTED] that is, [REDACTED]. In particular, I am housed in the [REDACTED]

[REDACTED] which has a decades-long tradition of being one of the leading research centers in the study of the mechanics of the large structures necessary to advance infrastructure in space, from deployables to in-space manufacturing. The topics of this sabbatical research proposal directly align with this tradition and extend it to focus on the current and future needs of NASA, the Department of Defense, and the aerospace industry.

In addition, this project will not only further my interactions and research collaborations with leading institutions such as [REDACTED] but also will provide opportunities for my students and colleagues (other CU Boulder faculty, both within [REDACTED] as well as other departments) to meet and interact with external collaborations. It is my hope that this exchange will result in new projects and collaborations for faculty within my department. This exchange will also help students at CU Boulder to secure internships and employment opportunities.

The successful implementation of this sabbatical project will also benefit my teaching and mentoring. It will expose me and, more importantly, my research students, to novel problems, ideas, and techniques. It will also allow me to update my undergraduate and graduate courses with current examples and state of the art problems, that I will feature in projects and other assignments. Finally, I will aim to engage the researchers from leading institutions as guest lecturers and mentors of research students, such as members of PhD thesis committees or hosts for students visiting their institutions during summer.

(4) Describe how your sabbatical project will enhance the university's reputation.

If successful, my proposed sabbatical project will advance the state-of-the-art design, manufacturing, and testing of the novel aerospace structures necessary to enable future scientific missions. In particular, I aim to consider several problems of current interest to NASA and the aerospace industry, such as the manufacturing and recycling of structures in-space, and lunar infrastructure. The resulting technical advances will be disseminated both through refereed journal articles as well as proceedings and presentations at relevant conferences, which will in turn enhance the University's scientific impact and reputation.

I also anticipate my proposed sabbatical project will lay the groundwork for future grant proposals leveraging the progress achieved through the proposed sabbatical project, which, if successfully funded, will also enhance the University's reputation and research metrics. I will also give presentations and interact with faculty at top-tier national and international institutions during my proposed sabbatical project, and I plan to heavily promote CU Boulder, and in particular relevant research and educational activities within the [REDACTED] [REDACTED] during these university visits. I also plan to directly involve my students (both graduate students and undergraduate research assistants) in the research projects resulting from these collaborations. These will not only expose other institutions to the quality of CU Boulder students but also help them establish connections that will facilitate their search for employment with these institutions after their graduation.

Finally, I will also plan to invite collaborators from these institutions to visit the University of Colorado Boulder. They will give guest lectures and seminars, meet with other faculty working on similar areas, and interact with students (both in my research groups and those of other faculty) whose research is close to their expertise. This will provide them the opportunity to strengthen their positive opinion of the university, build collaborations beyond my research group, and be exposed to the scientific success from CU Boulder.

(5) Describe how your sabbatical will contribute to the educational experience of students.

Due to my role as a teacher and research mentor, my sabbatical will directly contribute to the educational experience of students at CU Boulder. First, it will involve my actively advised

[REDACTED]

students (graduate and undergraduate research assistants) in research collaborations with leading institutions such as [REDACTED]. This will not only expose them to other approaches to research and new knowledge, but also allow them to present their research, network with leading researchers in their chosen field, and possibly help them secure internship or job opportunities. If funded, the future proposals that will result from this sabbatical will support new students through GRA and undergraduate assistantships, as well as provide them with funding to attend conferences and present their research to a wider audience.

Second, I teach two elective courses, [REDACTED] that are directly related to the research that will be conducted under this sabbatical project, as well as with the expertise I will obtain from collaborating with other researchers. I intend to teach the courses again after the sabbatical, incorporating my new research results, as well as the expertise acquired from my collaborators. I will also invite these new collaborators to give guest lectures in both of my courses. I have previously invited researchers from local industry [REDACTED] to give guest lectures in prior offerings of those courses, which has been very well received by the students. Additional guest lecturers will only enhance the courses and expose the students to a wider range of leading researchers in the area.

Finally, I am regularly involved with teaching our [REDACTED] [REDACTED]. The course requires students to design, build, and test an engineering solution for a practical industry or research problem within the [REDACTED] industry, including interacting with industry mentors to guide them and provide additional advice. My activities within this sabbatical project will provide ideas for new projects and industry mentors.

Part 2: REMUNERATION AND FUNDING PLAN

Regarding external funding, faculty members applying for sabbatical assignments are expected to apply for external funding (such as fellowships, grants, or clinical work) when appropriate. The total university salary to the faculty member, from sabbatical pay and any contract or grant administered through the university, shall not exceed university limits. There is no restriction on additional non-university income, subject to the faculty member satisfying the duties of the sabbatical plan and any contract/grant requirements. If a faculty member on sabbatical anticipates funding, sponsorship, employment, gifts, non-financial support, or other benefits from foreign institutions or sources, these should be detailed in the sabbatical remuneration plan, and all appropriate Export Control procedures should be followed. In addition, faculty members on sabbatical leave are not permitted to be paid for any administrative appointments or extra teaching during the sabbatical period.

- (6) Per CU System APS 1024, it is expected that faculty members applying for sabbatical will also apply for **external** funding to the extent it is available. Describe any anticipated external funding sources, amount of funding from sources external to CU, and attempts to obtain such funding.

Part of my sabbatical will be supported by existing research grants that align with the proposed work. This include a Defense Advanced Research Projects Agency (DARPA) project to more efficiently use metal alloys in aerospace structures, as well as an National Science Foundation (NSF) project that explores bee honeycomb construction as an inspiration for the distributed construction of lightweight structures (I will seek additional funding through an NSF Research Collaboration Opportunity in Europe for international travel and collaboration). In addition, I am actively working to obtain additional funding, particularly to visit other research institutions. These include JPL and AFRL funding for visiting faculty, a visiting position at Aix-Marseille University.

- (7) Describe the source and amount of any additional funding to support your sabbatical, including departmental or gift funding.

I have secured between three and four months of support from already existing research projects that align with the proposed sabbatical. I am currently seeking other opportunities, such as support from the institutions I plan to visit, or grants supporting travel and mobility such as the Fulbright or the NSF Research Collaboration Opportunity in Europe. Finally, I will also submit to obtain [REDACTED] in discretionary funds to support expenses for research, travel, etc. during sabbatical from CEAS.

- (8) Describe any anticipated support from foreign or international entities, including research collaborators, host universities, or other institutions, (e.g., equipment use, office/lab space, lodging or travel).

I will seek economic support for lodging, travel, and living expenses from the research institutions listed in this proposal. I also expect that temporary office space and access to lab space for collaboration in research will be provided.

- (9) Under the University's [APS 1024](#), faculty must identify business expenses to be reimbursed in connection with a Sabbatical Plan. Please describe anticipated business expenses and the funding source for those expenses.

[REDACTED]

No business expenses are expected, besides travel-related expenses, that will be covered either by grants secured by myself or by the host institution.

(10) Will this plan require international travel? If so, please describe the travel including anticipated destination(s).

The plan will require international travel to visit establish new collaborations. Although preparations have not finalized, this will likely include [REDACTED]
[REDACTED] The length of the stay will depend on specific plans and the securing of funding.

Part 3:
DEPARTMENT CHAIR/UNIT HEAD
PLAN FOR COVERAGE AND REMUNERATION

Based on the corresponding CU System [APS 1024](#), the dean of the school/college shall ensure that the costs associated with the sabbatical are covered, including teaching replacement expenses. The dean may suspend a sabbatical if funding is not available in the school/college. Remuneration (from university resources such as state funding, university administered grants or contracts, or any other university managed sources) for the sabbatical assignment shall be as follows: for full-time faculty on nine-month appointments, either full salary for one semester or half salary for two semesters; for full-time faculty on 12-month appointments, six months full salary or 12 months half salary. Please note that for single semester sabbaticals, remuneration from university-managed funds or university-administered grants or contracts should not exceed 100% of the faculty member's salary. For two-semester sabbaticals, remuneration sourced from General Funds (Fund 10) should neither be used to supplement a half-salary, nor exceed 50% of the faculty member's usual base salary. Stipends for administrative duties, such as chair or center director stipends, are not included in "base salary" and shall not be taken into account in calculating the individual's salary while on sabbatical.

- (11) Describe the plan for coverage of the faculty member's teaching responsibilities and replacement of teaching expenses. If it is known at the time this application is being made, include specific course names or numbers to be replaced each semester.

Prof. [REDACTED] regularly teaches our [REDACTED]. This course is offered twice a year and will be taught by Prof. [REDACTED] (Fall 2025) and Prof. [REDACTED] (Spring 2026). [REDACTED] has also taught our [REDACTED] which is being reformed to accommodate new department needs and will be taught by a team of faculty members led by Prof. [REDACTED].

Prof. [REDACTED] typically alternates teaching the [REDACTED] (which is cross listed as a senior elective) and [REDACTED]. These courses are not required for students to graduate, and only serve as general [REDACTED] electives, or electives in the focus area of Fluids, Structures, and Materials. Other faculty members in the area will teach sufficient courses to ensure that all graduate students have enough graduate courses available to satisfy their graduation requirements.

- (12) If the applicant is in an additional administrative position (e.g., chair or director), indicate how the administrative responsibilities will be covered.

The applicant is not in an additional administrative position.