



## **Out of This World: A University Partnership Model for Functional Clothing Design**

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### **Introduction**

University collaborations with external partners can be difficult to initiate, especially in early-stage or emerging topics. External collaborators may be reluctant to commit the level of funding required to ensure that the topic is given adequate attention, and low-stakes mechanisms are relatively rare. Here, we present a successful model for collaboration between universities and NASA, which uses existing project-based coursework as a vehicle for exploration of emerging topics. This model leverages existing structures, reducing the financial and intellectual commitment of both University and NASA research partners, and facilitating pilot investigations for exploration of potential areas for more in-depth research. We outline the logistical structure and benefits for University and NASA partners over 1.5 years of collaboration.

### **Project Background: Collaborative Foundation**

The basis for the development of this model was an emerging interest in collaboration between the University of Minnesota's Wearable Technology Lab (WTL) and the Johnson Space Center's (JSC) Human Interfaces Branch (HIB). HIB research was beginning to explore on-body interfaces and e-textiles, and shared many of the research and development objectives of on-going research in the WTL. While shared interests such as this are reasonably common, they often fall by the wayside due to lack of an appropriate mechanism that benefits all stakeholders and sufficiently lowers barriers to collaboration.

In our case, a useful solution was found in integrating the objectives of two additional stakeholders: an existing functional apparel design course at the University of Minnesota, and the NASA-funded Minnesota Space Grant Consortium, dedicated to expanding opportunities for students to engage with NASA research and careers. Table 1 outlines some of the more prominent stakeholder objectives at the outset of this collaborative course project.

The design of functional apparel is typically under-represented in undergraduate apparel curricula, just as professionals with an apparel background are often under-represented in fields where functional apparel is designed. From the University side, a collaborative project with a partner as exciting as NASA engages students in a way that previous project topics have not. From the point of view of the NASA mentors, apparel students offer a skill set (sewing, patternmaking, functional garment design) that is notably absent in most branches of NASA research. Finally, the additional focus on the emerging area of wearable technology and e-textiles both requires and facilitates direct collaboration between the faculty instructor and the NASA researcher. The sum of these influences results in a project that is a real, salient contribution to ongoing and emerging work – rather than a classroom “simulation”, or situation in which students feel that they are not doing “real” work – and decreases the perceived “burden” on external collaborators.

**Table 1: Stakeholder objectives**

<b>NASA/Researchers/Space Grant</b>	<b>University/Students/Faculty</b>
Engage University students in NASA research/careers	Expose students to real-world problems
Expose under-represented minorities to STEM education/careers	Raise profile of student work
Explore emerging topics with minimal investment	Engage students in functional apparel design
Make efficient use of time	Motivate student interest and stimulate high level of performance
Obtain test prototypes	Explore/pilot test emerging research topics
Compensate for unusual/absent skill sets	

### Course Project Structure

Our initial collaboration involved 16 students working in teams of 3-4 on one of 5 projects proposed by 5 NASA mentors. Students conducted an in-depth literature review phase to familiarize themselves with the core content of their project topic, a preliminary design/research phase where students conducted original research and developed test prototypes to determine a final design direction, and a final design phase where final prototypes were developed and constructed. Teams presented their results at JSC during a one-day symposium bringing together University and JSC researchers as well as students.

This model has since been expanded in the second year to include two additional universities, (approximately 40 students, 13 projects, 11 mentors, and 9 topics). Students now come from engineering and industrial design backgrounds as well as apparel, but all are working on body-worn technologies, clothing, or electronic textiles.

### Outcomes

**Student engagement:** Although focusing on the science and engineering side of apparel is not always the most popular topic for fashion students, student engagement with the apparel design course is exceptionally high. Comments from course evaluations include: “This class will be the highlight of my college career!”, “I think I can safely say this was the coolest school assignment I’ve ever had. It was so much fun to feel like we were truly contributing to a need.” and many more. Student performance also saw a steep increase.

**Visibility:** The collaboration was covered by many local and national news outlets, both general (local news media) and field-specific (Aviation Week, JSC Roundup, NASA TV). Student work was accepted to an international exhibition and won a national award.

**Research:** Student projects produced tangible, useful results, which eventually led to peer-reviewed publication, patent disclosures, and ongoing development of NASA technology, as well as contributing to ongoing funded research and a new funded NSF grant application (higher-stakes vehicles to support more in-depth collaboration).

**Structure:** The model developed through our initial collaboration of leveraging shared research interest of NASA researchers and university faculty in parallel with existing project-based coursework and engagement of local Space Grant Consortia is emerging into a “research cluster” concept that NASA and the local Space Grants are exploring for other focused sub-disciplines.