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Creating an Experimental Learning and Research Driven Spacesuit Lab for ERAU

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The world is on the cusp of a renaissance in human spaceflight with as many as a half a dozen different vehicles being developed to take crew and passengers to suborbital, orbital, deep space, and planetary surface destinations. Most missions will require critical enabling spacesuit technology to protect humans from the harsh space environment. Accordingly, a new wave of researchers and operators will be required. To address these unique requirements, the Spaceflight Operations Program at Embry-Riddle Aeronautical University (ERAU) is developing the Spacesuit Utilization of Innovative Technology Laboratory, or S.U.I.T. Lab. The S.U.I.T. Lab will provide a curriculum-based experiential focused goal of teaching ERAU students about the fundamentals of spacesuit operations in simulated environments starting with intravehicular activities in spacecraft cabins and extending to analogue research in simulations with extravehicular activities. The research-focused goals of the S.U.I.T. Lab will provide a testbed for industry partners to receive feedback, data, and recommendations for spacesuit design with innovative solutions while simultaneously providing ERAU with research opportunities for faculty as well as undergraduate and graduate thesis work and technology development. This paper covers how the S.U.I.T. Lab was established with minimal funds and provides an overview of early investigations. New course development to complement the lab is discussed including a pilot summer study abroad course. Five strategic areas were identified for the S.U.I.T. Lab including: spacecraft cabin mockup; motion capture; field/analogue research; education; and spaceflight physiology data.

Nomenclature

AAS	=	Applied Aviation Sciences
CoA	=	College of Aviation
CoAS	=	College of Arts and Sciences
CSO	=	Commercial Space Operations
ERAU	=	Embry-Riddle Aeronautical University
EVA	=	extravehicular activities
FFD	=	Final Frontier Design
FMARS	=	Flashline Mars Arctic Research Station
HI-SEAS	=	Hawai'i Space Exploration Analog and Simulation
HRP	=	Human Research Program
ICES	=	International Conference on Environmental Systems
IVA	=	intravehicular activities
IRB	=	Institutional Review Board
JSC	=	Johnson Space Center
MEERS	=	Mobile Extreme Environment Research
NEEMO	=	NASA Extreme Environment Mission Operations
S.U.I.T. Lab	=	Spacesuit Utilization of Innovative Technology Laboratory
SpaceOps	=	Spaceflight Operations Program
SSFS	=	Suborbital Space Flight Simulator
TA	=	Technology Area

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I. Introduction

TO understand our place in the universe, humanity must leave the cradle of Earth to explore the cosmos. To survive in the harsh environment of space, explorers will require humankind's tiniest spaceship: the spacesuit. The world is on the cusp of a renaissance in human spaceflight with as many as a half a dozen different vehicles taking crew and passengers to suborbital, orbital, deep space, and planetary surface destinations. Many of these vehicles will require critical enabling spacesuit technologies to protect humans from harsh environments including launch, entry, abort, micro-gravity, and dusty planetary surfaces, each having unique mobility requirements. Accordingly, a new wave of researchers and operators will be required that are familiar with spacesuit capabilities and operations. The spacesuit curriculum under development in the Spaceflight Operations (SpaceOps) Program (formerly Commercial Space Operations, CSO) of the Applied Aviation Sciences (AAS) Department in the College of Aviation (CoA) at Embry-Riddle Aeronautical University (ERAU) has the unique challenge of educating non-engineering students about an extremely technical space system. The course development directly complements the establishment of the Spacesuit Utilization of Innovative Technology Laboratory, or S.U.I.T. Lab, which will be integral to hands-on course work. The short history and S.U.I.T. Lab goals presented in this paper are aimed at fostering collaboration and aid other researchers who may be considering growing a technical laboratory from concept to reality.

II. Background

A. S.U.I.T. Lab Goals

The S.U.I.T. Lab will provide a curriculum based, *experiential-focused goal* to train ERAU students about the fundamentals of spacesuit operation in simulated environments starting with intravehicular activities (IVA) in spacecraft cabins and extending to analogue research in mission simulations with extravehicular activities (EVA). In the same way an electrical engineering student conducts hands-on lab work with circuit board design, this SpaceOps-based lab will provide experiential learning opportunities with spacesuits and related technologies ensuring successful student transition into the workforce of dozens (to hundreds including outreach programs) of students per year. Lessons learned from the earliest EVAs (see Figure 1) throughout our short spaceflight history can be aligned with cutting edge technology to help advance new spacesuits and train the next generation of operators.

The *research-focused goal* of the S.U.I.T. Lab will provide a testbed for industry partners to receive feedback, data, and recommendations for spacesuit design with innovative solutions while simultaneously providing ERAU with research opportunities for faculty. It will also provide a platform for undergraduate and graduate thesis work and technology development, catalyzing graduate degree streams in SpaceOps. It is envisioned that seed funds from ERAU grants and department support will catalyze high-impact technology-based S.U.I.T. Lab research projects and peer-reviewed publications, leading to international recognition and external funding.

The interdisciplinary S.U.I.T. Lab is working to first link the SpaceOps program with key ERAU stakeholders in human spaceflight. Collaborations are under development with the following ERAU programs: the Suborbital Space Flight Simulator (SSFS) and Mission Control Center (Professors Erik Seedhouse and Pedro Llanos in AAS, CoA); Human Factors Department (College of Arts and Sciences (CoAS)) and the Mobile Extreme Environment Research (MEERS) Lab (Professor Jason Kring); Aerospace Engineering (College of Engineering); and the new Aerospace Physiology program (CoAS). External collaborations with aerospace and non-aerospace partners are underway and are discussed later in the paper.

Figure 1. Ed White made the United States' first spacewalk on 3 June 1965 during the Gemini 4 mission.[1] ERAU students will learn about the history of spacesuit design with hands-on research contributing to the next generation of spacesuits and spaceflight operations.

B. NASA's Human Spaceflight Program

NASA's specific technology development needs are continually updated in their Technology Roadmaps,[2] with a focus on their Journey to Mars.[3] Spacesuits and EVA systems have cross-cutting necessities for future human exploration in several areas that overlap with the S.U.I.T. Lab objectives including two key NASA Technology Areas (TA): TA-6 "Human Health, Life Support, and Habitation Systems" and TA-7 "Human Exploration Destination Systems". Specifically: 6.2 Extravehicular Activity Systems; 6.3 Human Health and Performance; 7.3 Human Mobility Systems; and 7.5 Mission Operations and Safety.

Additionally, NASA has created an Integrated Extravehicular Activity Human Research Plan to conduct multi-disciplinary cost-effective research that will enable humans to perform EVAs safely, effectively, comfortably, efficiently, and on demand to enable and enhance human spaceflight exploration missions.[4] Within this plan, the Human Research Program (HRP) identifies "EVA Gaps" or topics to be investigated and mitigated. These include the highest risks to human health and performance, providing essential countermeasures investigation areas and technologies for human spaceflight exploration research.[5] Several of these can be mapped to spacesuit mobility, design, and astronaut safety, including EVA 6 through 11, 13, and 14. For example, HRP Gap EVA 9 ("What is the effect on crew performance & health of variations in EVA task design and operations concepts for exploration environments?") can be realized through field study testing in mission simulations at analogue locations by measuring EVA metrics including workload, duration, and examining fatigue before and after EVA. In short, there are myriad critical questions that must be addressed by a spacesuit-focused laboratory.

C. ERAU and CoA Vision

Current and planned activities at the S.U.I.T. Lab directly align with the ERAU College of Aviation's new 2017-2022 Strategic Vision, *Excellence by Design*. Echoed across all seven goals of this vision is the desire to increase research, foster collaborations on campus and with industry, motivate students to become global leaders, and the creation of a world class curriculum which, for SpaceOps, may lead to graduate level programs. Research drives graduate programs by the creation of master's and doctoral thesis work. The cutting-edge technology of spacesuits is undeniably inspiring to explore in the classroom setting, but the experiential opportunities to work with subsystem technologies is extremely rare and sought after in aerospace academic programs, placing ERAU as a frontrunner in this field. SpaceOps was recently ranked in the Top 5 signature research areas identified by the ERAU President's Council, demonstrating the high relevance to the university. The CoA vision is a direct subset of the ERAU Daytona Beach Campus goals in the 2016-2021 Strategic Plan, *Bold Horizons*, furthering education and research excellence on the university's seven pillars. Responding to the University level ERAU Vision, the S.U.I.T. Lab aims to be a source for innovation and excellence in aerospace education and applied research.

III. Methodology / Approach

A. S.U.I.T. Lab History

The SpaceOps S.U.I.T. Lab grew from a concept to an actual physical location rapidly in the Summer and Fall of 2016 with aspirations to conduct suborbital spacesuit human factors testing to generate research investigations. Limited resources (less than $1,500 USD) were committed first to the construction of a spacesuit test-rig, and second to the building of a spacecraft cabin mockup (seated frame in Figure 3). Initial plans included crowdfunding a pressure suit (like the demonstrator spacesuit in Figure 3) from Final Frontier Design (FFD), but committed department finances lapsed and spacesuit costs were much larger than anticipated, delaying the crowdfunding for reevaluation. In the Spring of 2017 steps were formulated to make the S.U.I.T. Lab operational and outline future project goals expanding to EVA projects.

The SpaceOps Program being relatively new gives it great potential for creative and cutting-edge projects in the spaceflight arena. The AAS Department created the S.U.I.T. Lab with some initial support including a 145 square-foot room (CoA 341, Room 339), two student employees (20 hours in the Fall and 10 hours in the Spring each), two computer workstations, course buyout for the manager each semester, and funds for basic construction

Figure 2. ERAU's U2 David Clark Co. pressure suit provides an interactive experiential learning experience for students across several CSO disciplines.

materials. This support was supplemented by the acquisition of a David Clark Company 1032S pressure suit manufactured in 1998. This suit had been used by an ERAU alumni U2 pilot who donated the suit (see Figure 2).

Figure 3. Final Frontier Design's demonstrator spacesuit in spacecraft cabin mockup during 2016 Project PoSSUM.

Figure 4. The external shell construction underway of the spacecraft cabin mockup.

B. Initial Steps

The first step in creating a spacesuit curriculum and identifying S.U.I.T. Lab research targets was accomplished by designing a study abroad program for the ERAU Office of Global Engagement as part of the Antikythera Mechanism program in Greece (Summer A - June 2017) titled "CSO 399: Spacesuits & Human Spaceflight Operations".[6] This course introduces students to human spaceflight topics including spacesuit history, design, human factors considerations, space life support systems, as well as IVA and EVA operations. The unique offering was designed to take advantage of the clear water visibility in the Aegean Sea by conducting practical underwater demonstrations of spaceflight operations, similar to activities conducted by NASA at Aquarius Reef Base during their NASA Extreme Environment Mission Operations (NEEMO) campaigns (see Figure 5).[7] The theme of the summer program is the history of spaceflight and exploration and its links to ancient navigation and technology while sailing around Greece focusing on unlocking the mysteries of the Antikythera Mechanism. The ultimate goal of the CSO 399 course is to introduce spacesuits and human spaceflight operations in-situ and build upon that knowledge to provide students with an understanding of the design process required to aid us in exploring the cosmos. The knowledge base will be used to help solve problems in future spacesuit development.

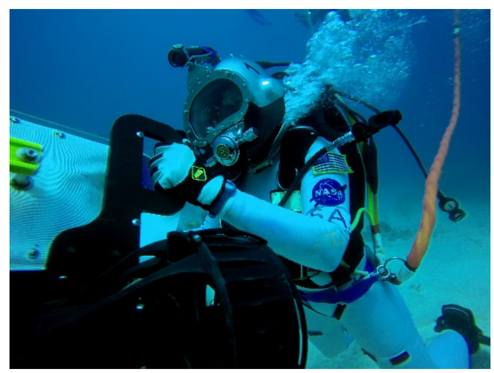

Figure 5. A spacesuit design and operations summer course will jump start SUIT Lab activities and add value to the ERAU Spaceflight Operations program.

C. Springing Forward

The CSO 399 course material was developed during the Spring 2017 semester (the initial results of the summer program will be presented at ICES 2017). To facilitate a baseline of resources and collaborations for research, an Independent Study (SP 425 Select Topics in Space/Aerospace) was conducted to survey spaceflight analogue facilities, create spacesuit demonstrations for underwater and the classroom, and actively participate in real spaceflight simulations. Opening the S.U.I.T. Lab to collaborations on EVA has already led to discussions with the NASA Johnson Space Center (JSC) on how the lab can contribute to the Integrated EVA Human Research Plan and data collection during the January-September 2017 Mars simulation at the Hawai'i Space Exploration Analog and Simulation (HI-SEAS) facility in Hawai'i.[8] An ERAU alumnus is part of the Mars simulation crew and has aided on an EVA Metrics and Spacesuit Mobility proposal. The goal of the proposal is to initiate a long-term partnership with the HI-SEAS mission management team and establish remote data acquisition techniques for both spacesuit mobility (range of motion) and EVA metrics (duration, task type, as well as biometric data).

The S.U.I.T. Lab spacecraft cabin mockup received department funding to support the lab's completion (Figure 4 is from the early Spring). During Spring 2017, motion capture equipment was calibrated to prepare for several research projects investigating range of motion and preliminary data. At present, the motion capture suit is not fully outfitted, but work is underway to acquire the necessary equipment to ensure operational capability. For example, cameras and markers were requested to support 2017-2018 research activities and were awarded within an internal ERAU grant. The S.U.I.T. Lab supported the Project PoSSUM (Polar Suborbital Science in the Upper Mesosphere) class 1701 and the Advanced PoSSUM Academy in April 2017, continuing the established relationship that previously included biometric and human factors data collection.[9, 20] Project PoSSUM is a suborbital research and education program devoted to the study of the upper atmosphere and the role it plays in the understanding of our global climate. The one-week intensive program on ERAU campus includes aerobatic flights, pressurized spacesuit operations training (FFD suit seen in Figure 6 in the SSFS), and hypoxia awareness training at the Southern AeroMedical Institute. The authors are evaluating activities that may be relevant for future research investigations when Project PoSSUM returns to ERAU in October 2017..

Figure 6. PoSSUM activities using pressurized (left) and unpressurized (right) FFD suits in ERAU SSFS.

D. Next Steps 2017-2018

The key steps to be taken during the 2017-2018 academic cycle are to mature the processes necessary to seek external sources of research funding and obtain an FFD demonstrator IVA pressure suit. Several areas of research can be initiated without the FFD spacesuit to prepare to use the suit efficiently, and a basic data acquisition (video capture not motion capture) trial was conducted with the assistance of FFD after Project PoSSUM Class 1701 while the suits were still on ERAU campus (see **Error! Reference source not found.**). During the upcoming year, it will be important to establish new collaborations with companies like FFD and organizations such as JSC, which will require site visits for meetings and future technology testing. Additional outreach activities may include presence at key industry conferences and workshops, depending on schedule availability, but most importantly right here on ERAU campus. FFD has already extended an invitation for a future visit. Underpinning these next steps are five strategic areas identified for the S.U.I.T. Lab to focus activities supporting the SpaceOps program goals. The areas and objectives are outlined in this section with metrics for success in the "Significance" section.

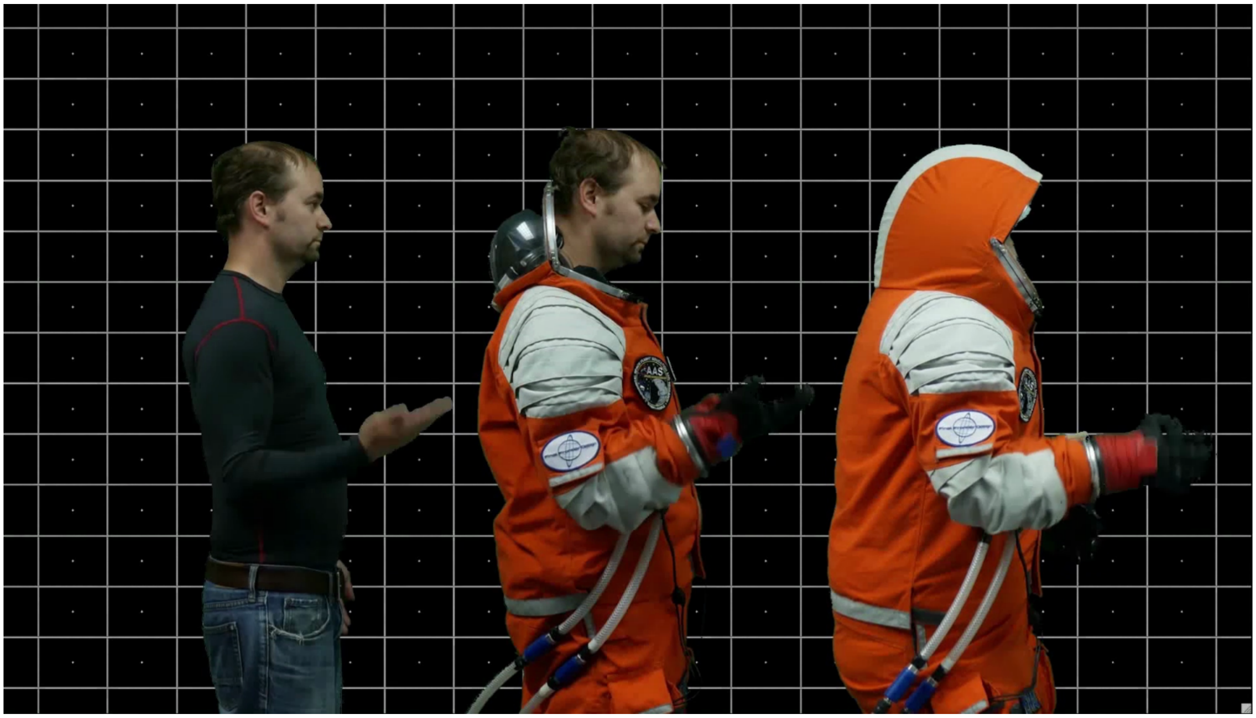

Figure 7: Basic video analysis was conducted with assistance from Final Frontier Design at ERAU to examine preliminary data acquisition techniques. The screenshot of the video analysis shows the subject (from left to right): unsuited; suited and unpressurized; and suited and pressurized to 3.5 pounds per square inch differential (psid). In this demonstration, elbow flexion and extension angles were measured.

1. *Motion Capture*
   - Assessing the acquisition procedure for range of motion data necessary for mobility testing. Mobility tests are conducted initially with the subject unsuited, then suited unpressurized, and finally suited pressurized (as seen in Figure 7). Previous work was conducted by the primary author as a Postdoctoral Associate in the MIT Man-Vehicle Laboratory with the David Clark Company (Worcester, MA) and their Contingency Hypobaric Astronaut Protective Suit.[10]
   - Operational checklist development for in-situ spacesuit measurements at field or spaceflight analogue locations (Mars simulations). Checklist derivation simultaneously prepares the S.U.I.T. Lab technicians to characterize on-loan or visiting spacesuits, such as the FFD suits used in the Project PoSSUM (as seen in Figure 3, Figure 6, and Figure 7).
   - Future work will include inertial measurement units for internal body dynamics versus external spacesuit motion[10] leading to metabolic cost (energy loss) calculations,[11] improved suit fit, and more efficient operations.

2. *Field/Analogue Research*
   - Operational tasks in spaceflight analogue environments, highlighted by mission simulations. Activities in the S.U.I.T. Lab will utilize unique simulated surface spacesuits within a task-oriented environment for several interdisciplinary studies conducted as a remote PI. Areas under review for investigations with several international partners (Hawai'i USA, Devon Island Canada seen in Figure 8, and Austria with surrounding locations) include:
     - Checklist development for EVA including spacesuit don/doff, maintenance, and emergency procedures such as field rescue.
     - Remote video capture for mobility analysis, demonstrations, and outreach.
     - EVA metric collection (mentored by JSC) including EVA duration, distance traversed, type (science, exploratory, etc.), frequency, and physiological data (see below) (previous work with Battler, 2008)[12]. This would also include data mining previous Apollo and simulation missions.

- Human factors data collection including spacesuit comfort, Modified Cooper Harper Rating Scales, NASA-Task Load Index, perceived workload or fatigue (before, duration, and post EVA or spacesuit don/doff), and work envelope as mentioned.
- Location of measured tasks both on land (USA, Canada, and Europe) and underwater (local pool, Aquarius Reef Base in South Florida, and SCUBA dives sites).

- Technology evaluations of spacesuits including center of gravity design, sizing, sensors usage for spacesuit torques,[13] and technologies aiding in exploration such as tools and heads up displays.
- Future work in lunar dust abrasion characterization and mitigation to surface operations based on primary author's Ph.D. dissertation work.[14-18]

Figure 8. A crewmember of the Flashline Mars Arctic Research Station (FMARS) four-month Mars simulation climbs *Castle Mercury* for a final view of Devon Island on the final EVA (Photo: R.L. Kobrick, Ph.D. 2007).

3. Spacecraft Cabin Mockup

- Assessing the work envelope with functional arm reach tests. This specifically evaluates pressure suits for IVA and design considerations for spacecraft cabins (previous work with Klaus, 2007)[19].
- Operational checklist development of ingress and emergency egress, a critical function for safe spaceflight exploration, particularly in the suborbital spaceflight industry, which is almost devoid of any guidance regarding required checklists and operational procedures by spaceflight participants, especially in the realm of wearing a pressure suit.
- Integrating virtual reality with a generic spaceceraft cabin mockup so that any spacecraft vehicle interior can be created for research projects. This focuses on user-spacesuit-couch interfaces but allows rapid reconfiguration of a cabin interior or early hazard identification.

4. *Education*
   - Generating spacesuit demonstrations for classroom environments of varying target demographics (K-12, undergraduate, and graduate levels). An example would be wearing ski gloves and putting a nut on a screw.
   - Generating basic spacesuit activities for the S.U.I.T. Lab to incorporate into SpaceOps ERAU courses such as emergency egress procedures.
   - Establishing benchmark tests for spacesuits optimizing the large pool of volunteers and diverse anthropometric sizes on campus.
   - Course development for new SpaceOps offerings, beginning with the CSO 399 Summer A program.
   - Advocating and advancing safety and injury awareness and prevention in the spaceflight industry and infusing that knowledge into classroom activities.
   - Enabling citizen science projects that directly correlate to S.U.I.T. Lab activities.
   - Public engagement using S.U.I.T. Lab social media, participation in campus events, and Yuri's Night activities. During the Spring semester, several tours were given to visiting guests and scholars (~123 visitors from internal tracking). The lab participated in several education events, highlighted by the March ERAU Astronomy Open House with approximately 1,000 visitors.
   - The S.U.I.T. Lab launched it's online presence with several assets with @SpacesuitUp as the golden thread:
     - Website: http://sites.erau.edu/spacesuit (http://spacesuit.erau.edu or http://erau.edu/spacesuit)
     - Instagram: https://www.instagram.com/spacesuitup
     - Twitter: https://twitter.com/spacesuitup
     - Facebook: https://www.facebook.com/SpacesuitUp

5. *Spaceflight Physiology Data*
   - Preliminary physiology work has been initiated in SpaceOps with Project PoSSUM including physiological data and g-force measurements of several participants using a Zephyr Bioharness (as used by NASA and in published peer-reviewed studies) and BioRadio instrumentation that consists of a skin conductance sensor, hand dynamometer, and spirometer (as used in university published peer-reviewed studies).[20]
   - Cross cutting research areas previously mentioned that can be linked to physiological data include workload and human performance, human factors activities, field EVAs, work envelope testing, and injury prevention, each of which can lead to spacesuit modifications and improvements. This may become the primary research focus for the S.U.I.T. Lab in the coming years.
   - Additional areas of interest include ground reaction forces, stress / strain on the spacesuit, carbon dioxide buildup, fitness levels, and pressure related risks such as decompression sickness.

E. Timetable

Recapping the lab strategic areas and objectives, the following timetable provides a task summary by semester.

2017	Spring	S.U.I.T. Lab strategic vision; CSO 399 prep; spacecraft cabin mockup assembly and initial data collection; motion capture calibration; ICES paper; PoSSUM; and setting up collaborations.
	Summer A	Antikythera Mechanism program exploring underwater analogues, CSO 399 in Greece.
	Summer B	Documentation of CSO 399 lessons learned; ICES; IRB training; and FA/SP research plans.
	Fall	Conference/workshop meeting(s); final construction; IRB submission(s); and pilot data.
2018	Spring	Cyclic research studies; grant writing; ICES paper; and conference/workshop meeting(s).
	Summer A/B	TBD.

F. Human Subjects

One of the strengths of conducting human spaceflight research at an aviation/aerospace focused university is the vast diversity pool of test subjects, who are highly motivated to experience "astronaut-like" activities. Preliminary discussions regarding proposed research activities and the degree of Institutional Review Board (IRB) approval required, have already been conducted. To that end, IRB training will be completed and IRB applications will be submitted for S.U.I.T. Lab research activities well in advance of publishable data collection.

IV. Significance

The main metric of the S.U.I.T. Lab's success will be the generation of peer reviewed conference papers and journal articles, presentations, educational offerings (as courses and public outreach), and collaborative partnerships providing significant theoretical and applied opportunities to students and faculty. Subsequently, the success of each student's involvement will be measured by their transition into the workforce with internships and full time positions after graduation. By the nature of the peer-review process, the research conducted in the lab is targeted to positively impact and support human spaceflight exploration. The high-profile and high-tech nature of spacesuits (and ancillary IVA and EVA equipment) will help ERAU establish cutting-edge investigations, aid in recruitment, retention of students, and foster increased global rankings in the Aerospace community. Although the S.U.I.T. Lab is housed in the CoA, the authors have an established publication track record in Aerospace Engineering and interdisciplinary fields of Systems Engineering, Operations, Materials Engineering, Human Factors, and Global Engagement and Outreach, which gives the lab competency to collaborate with other ERAU departments, colleges, campus, industrial (NASA and commercial) and non-aerospace partners, and other academic institutions.

The SpaceOps faculty at ERAU are research professors committed to sharing and training the next generation in scientific thought. By focusing research efforts through the single and interdisciplinary focal point of the S.U.I.T. Lab, a new cultural environment is being established in the SpaceOps program (and similarly in other SpaceOps labs). The lab has already led to teaching opportunities abroad and collaboration discussions.

The S.U.I.T. Lab is already contributing to industry with four papers at ICES 2017 including this paper. Two ICES papers are student-led,[21,22] and the fourth by another SpaceOps faculty examining spacesuit human factors data gleaned from the PoSSUM Project.[20] These publications are a starting point, but are intended to be revised to peer reviewed journal articles based on Spring and Summer findings. Work from the Independent Study has also led to a full length abstract submission that was accepted for the 2017 AIAA SPACE Forum in Spaceflight Operations.[23]

V. Concluding Remarks

A diversified research portfolio for the S.U.I.T. Lab will ensure that ERAU will be able to meet the needs of the spaceflight industry. The cyclic nature of national priorities for human exploration (Moon, Mars, other, repeat) will generate opportunities for faculty and students to contribute to humanity's ultimate destiny, space colonization. The early lessons learned via creating the S.U.I.T. Lab, and initial research plans presented in this paper, were presented to guide other academics seeking to enhance their classroom offerings with experiential learning. The early success is highlighted by the support by at the ERAU Department, College and University levels, including PI time (or course release effort) and physical space for the lab to flourish. The natural progression of seeking research funding and opportunities is only possible because the S.U.I.T. Lab designed focal research areas that fall into more general categories of IVA, EVA, and Surface Operation Systems.

The design of a summer aboard course allows for a lighter curriculum load (with respect to "lecture time") and to break down traditional school routines by instructing anywhere but a classroom. As an experimental course offering, study abroad enables course adjustments to rapidly evolve courses and ultimately entire programs. Additional curriculum packages are being explored for short courses and full semester offerings both in domestic away (for example at Aquarius Reef Base in Key Largo, FL) and study abroad locations.

Early testing and operations recommendations will be made at ICES 2017 based upon preliminary data collected in the S.U.I.T. Lab and experience working with Final Frontier Design and Project PoSSUM. This knowledge advancement will establish a baseline of capabilities and pilot data for external grant applications.

Creating an experiential learning and research driven spacesuit lab for ERAU has already generated enthusiasm amongst the faculty, staff, and students in SpaceOps and several other programs. This demonstrates at an early stage of the S.U.I.T. Lab's creation how important inspiring the next-generation with cutting-edge technology and unique opportunities can be, and how it fosters the desire to keep exploring the cosmos. NASA Astronaut (retired), ERAU Board of Trustee Member, ERAU graduate (DB '87), artist, and STEM advocate Nicole P. Stott (Figure 9)[24] continues to inspire students on every visit to campus and has experienced the thrill of walking in space. The big question remains: Who will be the next spacewalker on EVA from ERAU?

Figure 9. NASA Astronaut (retired), ERAU Board of Trustee Member, ERAU graduate (DB '87), artist, and STEM advocate Nicole P. Stott training for an EVA (spacewalk) for STS-128. Who will be the next spacewalker on EVA from ERAU?

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