Fiscal Year:	FY 2018	**Task Last Updated:**	FY 01/09/2018
PI Name:	Hayman née Anderson, Allison Ph.D.		
Project Title:	Interactive Space Vehicle Design Tool with Virtual Reality		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **HSIA**:Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	allison.p.anderson@colorado.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	417-388-0621
Organization Name:	University of Colorado		
PI Address 1:	Ann and H.J. Smead Aerospace Engineering Sciences		
PI Address 2:	429 UCB		
PI Web Page:			
City:	Boulder	**State:**	CO
Zip Code:	80309-5004	**Congressional District:**	2
Comments:	NOTE: name change to Hayman née Anderson (Ed., March 2025). PI moved to University of Colorado from Dartmouth College in early 2017.		
Project Type:	Ground	**Solicitation / Funding Source:**	2016-2017 HERO NNJ16ZSA001N-Crew Health (FLAGSHIP, OMNIBUS). Appendix A-Omnibus, Appendix B-Flagship
Start Date:	11/09/2017	**End Date:**	11/09/2019
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Williams, Thomas	**Contact Phone:**	281-483-8773
Contact Email:	thomas.j.will1@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date changed to 11/9/2019; grant number changed sometime in late 2018 (Ed., 1/31/19)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Klaus, David Ph.D. (University of Colorado - Boulder)		
Grant/Contract No.:	80NSSC18K0198		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Objective: To develop a virtual reality design tool that facilitates rapid mock-up and flexible design of microgravity vehicles and habitats. Research Product Description: Space vehicle design is critical to maximize crew efficiency, comfort, and equipment storage. Designers utilize mock-ups early in the design phase to experiment with ideas, but high fidelity mock ups can be costly and time consuming to produce. Therefore, many design decisions have been set in place by the time a high fidelity mock-up is created. Engineering drawings allow early assessment of vehicle design, but do not allow experimental evaluation of physical presence of people interacting with the system. Further, when testing mock-ups in 1G, our perspective is limited by our orientation and by interacting with the vehicle in 1G. This limitation is removed in microgravity, where astronauts interact with the vehicle or habitat in ways not possible on Earth. It can be challenging for designers to optimize spaces when thinking and working in 1G. To enable efficient and rapid mock-up of vehicle concepts, virtual reality can be used earlier in the design process to achieve improved system design. Specific Aim 1: Create a virtual reality design tool for space vehicles and habitats. The virtual reality (VR) tool will represent a physics based simulation of the microgravity environment. The visual perspective of the user can be rapidly switched to simulate that of a person in microgravity. A major component of vehicle design is optimizing storage and usable space. By simulating how the objects the user will interact with in microgravity, design improvements can be identified earlier in the design process. Specific Aim 2: Evaluate tool effectiveness in a vehicle mock-up experiment. The interactive VR design tool developed in Specific Aim 1 will be evaluated in comparison to a mid-fidelity physical space vehicle mock-up. Subjects will perform sequential tasks simulating a science protocol to be performed in a microgravity vehicle. Environment order (VR or physical) will be counterbalanced and all subjects will be trained on the simulated science tasks in both environments prior to the start of the experiment to reduce the effect of learning. Subjects will be given a checklist to follow to ensure he or she adheres to the protocol. After the subject has completed 50% of the tasks, he or she will be given the option to reconfigure the workspace. No constraints on the nature of the reconfiguration will be given to the participants, and tasks will be sufficiently diverse such that there is no a priori optimal configuration for all tasks. NASA Relevance: This proposal addresses the Risk of Incompatible Vehicle/Habitat Design. Specifically, it addresses the Gap HAB – 05 to identify technologies and create a tool to enable the design and assessment of space vehicles. The development of this technology achieved in Specific Aim 1 and the validation of its use achieved in Specific Aim 2 will create a tool that can be applied in the future to other Risk objectives, such as assessing the effect of lighting in the habitat space, simulated vibration, or ergonomic evaluation.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2018.
Bibliography Type:	Description: (Last Updated: 03/26/2025)
Articles in Peer-reviewed Journals	Banerjee N, Baughman A, Lin S, Witte Z, Klaus D, Anderson A. "Side-by-side comparison of human perception and performance in augmented, hybrid, and virtual reality." IEEE Trans Vis Comput Graph. 2022 Dec;28(12):4787-96. http://dx.doi.org/10.1109/TVCG.2021.3105606 ; PMID: 34406940 , Dec-2022