Fiscal Year:	FY 2015	**Task Last Updated:**	FY 08/20/2015
PI Name:	Duda, Kevin R Ph.D.		
Project Title:	Wearable Kinematic Systems for Quantifying 3-D Space Utilization in the Microgravity Environment		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:		**TechPort:**	Yes
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:	kduda@draper.com	**Fax:**	FY 617-258-2772
PI Organization Type:	NON-PROFIT	**Phone:**	617-258-4385
Organization Name:	The Charles Stark Draper Laboratory, Inc.		
PI Address 1:	555 Technology Sq		
PI Address 2:	MS 27		
PI Web Page:			
City:	Cambridge	**State:**	MA
Zip Code:	02139-3539	**Congressional District:**	7
Comments:			
Project Type:	FLIGHT,GROUND	**Solicitation / Funding Source:**	2013-14 HERO NNJ13ZSA002N-ILSRA. International Life Sciences Research Announcement
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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:	Whitmore, Mihriban	**Contact Phone:**	281-244-1004
Contact Email:	mihriban.whitmore-1@nasa.gov		
Flight Program:	PostFlight		
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Jacobs, Shane Ph.D. (David Clark Company, Inc.)		
Grant/Contract No.:	NNX15AP28G		
Performance Goal No.:			
Performance Goal Text:			
	Astronauts living and working onboard the International Space Station (ISS) provide a unique opportunity to capture and quantify the “architectural layout and 3-D space utilization” in a microgravity environment. As NASA looks to design and build future space exploration vehicles, information gathered on the human-system operational environment on-board the ISS will provide critical data on the minimum net habitable volume (NHV) for these systems. This proposed research aims to produce a validated wearable kinematic system to unobtrusively determine an International Space Station (ISS) crewmember’s navigation state vector as a function of time for characterizing vehicle habitability to reduce the risk of incompatible vehicle/habitat design for future deep space exploration missions. We aim to leverage extensively the wearable kinematic and positioning systems that have been developed under prior NASA and U.S. Army Programs. In addition, we aim to leverage the decades of guidance, navigation and control, and perceptual systems		

Task Description:	experience of Draper Laboratory for navigation of complex systems in complex environments as well as our human-centered engineering capabilities. The overall goal of this project is to develop the concept of operations, high-level architecture, and requirements (crew/hardware/software) for International Space Station (ISS) transition of a wearable kinematic system to be used for quantifying 3-D space utilization in the microgravity environment. This shall be accomplished by demonstrating the vision+ inertial navigation algorithms for net habitable volume (NHV) metrics on a COTS (commercial off-the-shelf)/existing device in a ground based analog environment. The specific aims of this study are: (1) Definition of ISS Integration, Flight Definition, and NHV Model Requirements. This will include the specification of the technical, performance, functional, and operational requirements for the wearable kinematic system associated with ISS integration and analytics for NHV metrics calculation, as well as Flight Experiment Definition planning. (2) Wearable Kinematic System Design, Development & Verification. A system architecture trade study and detailed design for the wearable module development, testing to verify the performance in ground-based analog scenarios, and the requirements for transitioning the equipment for ISS spaceflight operations will be completed. (3) Quantification of ISS NHV Metrics. This aim develops the infrastructure and algorithms for calculating the relevant NHV metrics from the wearable module navigation state vector, including automating the process and providing intuitive visualizations of the data. This research will address the NASA Human Research Program (HRP) Program Requirements Document (PRD) Risk of Incompatible Vehicle/Habitat Design. The development and implementation of the proposed wearable kinematic system will provide a capability for the Integrated Research Plan (IRP) Gap SHFE-HAB-09 to collect data for the design and assessment of vehicles/habitats. Subsequently, this data will then address Gaps SHFE-HAB-03/05/07 for understanding how astronauts interact with the vehicle/habitat and informing guidelines for determining net habitable volume.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2015.
Bibliography Type:	Description: (Last Updated: 09/04/2023)