Fiscal Year:	FY 2018	**Task Last Updated:**	FY 05/13/2019
PI Name:	Rajulu, Sudhakar Ph.D.		
Project Title:	Quantification of In-flight Physical Changes - Anthropometry and Neutral Body Posture (NBP)		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
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) **Dynamic Loads**:Risk of Injury from Dynamic Loads (2) **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		
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Organization Name:	NASA Johnson Space Center		
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City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	Directed Research
Start Date:	08/31/2012	**End Date:**	09/30/2018
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
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Flight Program:	ISS		
Flight Assignment:	ISS NOTE: Element change to Human Factors & Behavioral Performance; previously Space Human Factors & Habitability (Ed., 1/18/17) NOTE: Extended to 9/30/2018 per E. Connell/HRP (Ed., 7/20/15)		
Key Personnel Changes/Previous PI:	2016: Removed Ryan Amick as Co-Investigator (Co-I) and added Han Kim, Ph.D., as Co-I. July 2015: Added Ryan Amick as Co-Investigator.		
COI Name (Institution):	Young, Karen B.S. (Leidos/Wyle/NASA Johnson Space Center) Dirlich, Tom (Technical University Munich (TUM), Germany) Kim, Han Ph.D. (Leidos/Wyle/NASA Johnson Space Center)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	NASA suit engineers and the Extra-Vehicular Activity (EVA) Projects Office have identified that suit fit in microgravity could become an increasing issue. It has also been noted that crewmembers often need to adjust their suit sizing once they are in orbit. This adjustment could be due to microgravity effects on anthropometry and postural changes, and is necessary to ensure optimal crew performance, fit, and comfort in space. To date, the only data collected in space to determine the effects of microgravity on physical human changes have been during Skylab, STS-57, and a recent Human Research Program (HRP) study on seated height changes due to spinal elongation, Spinal Elongation (Master Task List [MTL] 221, Principal Investigator Rajulu-- https://), (Young, 2011). Skylab and the STS-57 studies found that there is a distinct neutral body posture (NBP) based on photographs. Additionally, Skylab studies found that crewmembers could experience a stature growth of up to 3 percent. The Spinal Elongation study identified that the crewmembers could experience about a 6 percent growth in seated height and a 3 percent stature growth, when exposed to microgravity. The results thus prove that not all anthropometric measurements have the same microgravity percent growth factor. In order for EVA and the suit engineers to properly update the sizing protocol for microgravity, they need additional anthropometric data from space. Hence, this study was funded by EVA to gather additional in-flight anthropometric measurements, such as lengths, depths, breadths, and circumferences to determine the changes to body shape and size due to microgravity effects. It is anticipated that by recording the potential changes to body shape and size, a better suit sizing protocol will be developed for International Space Station (ISS) and other space missions. In essence, this study will help NASA quantify the impacts of microgravity on anthropometry to ensure optimal crew performance, fit, and comfort. Additional in-flight physical changes due to neutral body postures (NBP) and the effects of spaceflight on NBP during extended exposure to microgravity also need to be quantified. This study will use simplistic data collection techniques, digital still and video data, to perform photogrammetric analyses to determine the changes that occur to the body shape, size, and NBP while exposed to a microgravity environment. The aim of the study is to collect data from a minimum of three subjects per year over a four year time frame leading to a possible 9 subjects total. Data would be collected over multiple six month increments starting with increment 39/40 in November 2013. A minimum of three data collection sessions is required with an initial in-flight data collection session at approximately FD15. Anthropometric measurements will be collected from crew participants during one pre-flight BDC (baseline data collection), three in-flight data collection points (early, mid, and late at minimum), and one post-flight BDC session. In-flight data collection will include photo and video based measurements for body lengths and postures, as well as tape measure measurements for body segment circumferences. Ground based BDC data collection sessions will be performed in the US Lab mockup and in the Anthropometry and Biomechanics Facility at Johnson Space Center (JSC).
Rationale for HRP Directed Research:	This research is directed because it contains highly constrained research, which requires focused and constrained data gathering and analysis that is more appropriately obtained through a non-competitive proposal.
Research Impact/Earth Benefits:	
Task Progress:	During FY18, the study completed data collection and analysis of 9 subjects. The results have shown similar trends to the historical data--stature resulted in an increase in growth within the first 15 days of spaceflight and then a plateau for the duration of the Mission. Other measurements exhibited common trends within and between subjects while some measurements were highly variable due to marker and posture variability.
Bibliography Type:	Description: (Last Updated: 03/25/2020)