Fiscal Year:	FY 2009	**Task Last Updated:**	FY 10/08/2009
PI Name:	Cavanagh, Peter R. Ph.D., D.Sc.		
Project Title:	Monitoring Bone Health by Daily Load Stimulus Measurement during Lunar Missions		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Musculoskeletal Alterations Team		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Bone Fracture**:Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) **Osteo**:Risk Of Early Onset Osteoporosis Due To Spaceflight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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PI Organization Type:	UNIVERSITY	**Phone:**	206-221-2845
Organization Name:	University of Washington		
PI Address 1:	Department of Orthopaedics and Sports Medicine		
PI Address 2:	School of Medicine		
PI Web Page:			
City:	Seattle	**State:**	WA
Zip Code:	98195-6500	**Congressional District:**	7
Comments:	PI moved from Cleveland Clinic to University of Washington in June 2008 (8/08)		
Project Type:	GROUND	**Solicitation / Funding Source:**	2007 Crew Health NNJ07ZSA002N
Start Date:	10/01/2008	**End Date:**	09/30/2012
No. of Post Docs:	1	**No. of PhD Degrees:**	0
No. of PhD Candidates:	1	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Lang, Thomas (University of California, San Francisco) Grodsinsky, Carlos (ZIN Technologies, Inc.) Gilkey, Kelly (NASA Glenn Research Center)		
Grant/Contract No.:	NCC 9-58-MA01603		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	One of the key questions that remains unanswered as we prepare for prolonged lunar sojourns is the degree to which living and exercising on the lunar surface will provide an osteoprotective stimulus to prevent the loss of bone mineral that has been observed in microgravity. The concept of daily load stimulus is useful in this regard, since it has the potential to estimate the "dose" of load to the lower extremities that will maintain skeletal integrity even in the setting of concurrent therapeutic drug and exercise countermeasures. Most observers believe that some form of supplementary exercise will be required during lunar activity but this will need to be optimized to provide the most efficient use of crew time. We are in the process of developing and validating a miniaturized accelerometer-based system that could be used during IVA and EVA on the lunar surface to monitor the complete daily load stimulus to the lower extremity and interpret that information in relation to bone health. After validation in the enhanced Zero Gravity Locomotion Simulator (eZLS) at NASA Glenn Research Center and the lunar bedrest analog at UTMB, a deliverable of this project will be a system, the aDLS (Accelerometric Daily Load Sensor), including a small shoe-mounted unit that will transmit signals to a portable data logger that could potentially be used to collect data on other physiological systems simultaneously. On-board software with visual feedback will determine how much additional exercise is required each day to maintain bone homeostasis. This high TRL project combines theory, experimentation, and hardware development to produce a device that will be a critical component in the effort to maintain bone health during lunar missions. The project is a collaborative effort between the University of Washington, the Exercise Countermeasures Laboratory at NASA GRC, ZIN Technologies, and the University of California, San Francisco.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Accurate and detailed ambulatory activity monitoring with the added benefit of software predicting bone health is a tool that would be highly sought after by athletic communities, the aging population, osteoporotic patients, and elderly care personnel. This project has the potential to produce a NASA spin-off that would benefit the mentioned populations through personal bone health monitoring systems. In 2005, osteoporosis-related fractures in the US were responsible for an estimated $19 billion in medical expenses. This estimate is expected to rise to $25.3 billion by 2025. The personal monitoring system being developed under this grant can help individuals manage their bone health based on personal exercise goals and real-time feedback. Use of this hardware could help significantly decrease medical costs related to osteoporotic fracture.
Task Progress:	Year one of the MBH project has focused on the following : 1) hardware specification and development 2) prototype fabrication 3) facility readiness (including fabrication of support hardware to meet scientific endpoints) 4) IRB approval (in preparation for Year 2 activities). At the end of year one we have made significant progress on each item, as described below. 1) Hardware specification and development & 2) prototype fabrication: Science requirements have been identified and have aided in sensor identification. ZIN Technologies, a subcontractor on this grant, has designed a breadboard unit utilizing components which minimize size, mass, and power requirements while maximizing battery life and data transfer capabilities. Breadboard design and physical layout of components is complete. PCB assembly is scheduled to be complete before the end of Year 1. Completion of the prototype unit will allow for initial data collection and review of the products ability to meet scientific objectives. The hardware Preliminary Design Review is scheduled to occur at the beginning of Year 2. 3) Facility readiness (including fabrication of support hardware to meet scientific endpoints): NASA Glenn Research Center houses the enhanced Zero-gravity Locomotion System (eZLS) on which our prototype hardware will be tested in a series of two pilot studies. The third specific aim of this project is "To demonstrate the feasibility and validity of the approach in 1g, in 1/6g in the eZLS, and in the 1/6g lunar bedrest analog". Utilization of the eZLS provides the means to test the equipment in simulated microgravity and 1/6g environments. Another goal of the project is to test the hardware while typical lunar activities are being performed. A list of lunar activities has been adapted from NASA's Functional Task Test protocol for inclusion in our study. These include a rock translation, platform jump down test, and obstacle course maneuvering. Specialty hardware needs have been identified and engineers have been assigned to the task of fabrication and integration. Funds are allocated in the Year 2 for fabrication and integration of these lunar task items. 4) IRB approval: Full applications for human subject approval were sent to the University of Washington and the NASA CPHS Intstitutional Review Boards (IRBs) for approval. To date, full approval from the University of Washington has been granted and conditional approval has been granted by CPHS with minor stipulations. Full approval from CPHS is anticipated before the start of Year 2.
Bibliography Type:	Description: (Last Updated: 03/08/2018)