Fiscal Year:	FY 2013	**Task Last Updated:**	FY 02/06/2014
PI Name:	Qin, Yi-Xian Ph.D.		
Project Title:	Portable Quantitative Ultrasound with DXA/QCT and FEA Integration for Human Longitudinal Critical Bone Quality Assessment		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	NSBRI--Smart Medical Systems and Technology Team		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **ExMC**:Exploration Medical Capabilities		
Human Research Program Risks:	(1) **Medical Conditions**:Risk of Adverse Health Outcomes and Decrements in Performance Due to Medical Conditions that occur in Mission, as well as Long Term Health Outcomes Due to Mission Exposures (2) **Renal Stone**:Risk of Renal Stone Formation		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	11794-5281	**Congressional District:**	1
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2012 Crew Health NNJ12ZSA002N
Start Date:	09/01/2013	**End Date:**	08/31/2016
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:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):			
Grant/Contract No.:	NCC 9-58-SMST03401		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Skeletal complications, i.e., osteoporosis, induced by microgravity during extended space mission, represent a key astronaut health problem. Lack of on-board diagnosis has increased significant risk in astronauts' bone loss during long term space flight. Early diagnosis of such disorders can lead to prompt and optimized treatment that will dramatically reduce the risk of fracture and longitudinal monitoring microgravity and countermeasure effects. Advents in quantitative ultrasound (QUS) techniques provide a method for characterizing the material properties of bone in a manner for predicting both bone mineral density (BMD) and mechanical strength. We have developed a scanning confocal acoustic navigation (SCAN) system capable of generating noninvasive ultrasound images at the site of interest. Both animal and human tests indicated strong correlations between SCAN determined data and microCT determined BMD, and bone strength, as well as monitoring fracture healing with guided ultrasound. The objectives of this study are to develop a portable broadband SCAN for critical skeletal quality assessment (e.g., hip, knee, wrist, and heel), to longitudinally monitor bone alteration in disuse osteopenia, and to integrate ultrasound with DXA (dual-energy X-ray absorptiometry), QCT (quantitative computed tomography), and finite element analysis (FEA) for human subject. In vivo human tests will be evaluated at Stony Brook Osteoporosis Center and the Johnson Space Center/University of Texas Medical Branch (JSC/UTMB) bedrest facility. Human cadaver will be used for testing feasibility of identifying bone loss, microstructural and mechanical strength properties. The goals will be achieved by a series of specific aims (S.A.s). 1) To develop a new broadband SCAN system capable of extracting trabecular quantitative ultrasound (QUS) parameters and backscatter images at critical skeletal sites using single crystal material transducer with minimal loss of the acoustic signal and integration with scan technology to provide direct assessment of the risk of osteoporotic bone loss and fracture in the deep tissue. The scanning time will be less than 2 min. The SCAN system will be non-invasive, portable, easy to use, and provide automatic analysis. 2) To evaluate the capability of the broadband SCAN diagnostic system in assessing trabecular bone structural and strength parameters in cadaver subjects with microCT determined microstructure and BMD determined by DXA. 3) To longitudinally assess and correlate the degree of bone loss in osteoporosis clinic, bedrest facility to determine intra-subject bone loss and the relationship to age, gender, and rational effects at critical sites using SCAN, DXA, QCT, and FEA. 4) To determine the ability of quantitative ultrasound in pre- and post-flights, as well as rehabilitation effects for astronauts. Relevance: Skeletal decay generated by the microgravity environment has greatly impacted the nation's civil space missions and ground operations. Such musculoskeletal complications are also major health problems on Earth, i.e., osteoporosis. Development of a noninvasive diagnostic and treatment technology using noninvasive ultrasound with new crystal transducer technology will have a great potential to perform longitudinal measurement of bone alteration and prevent the risk of fracture. This research will address critical questions in the NASA Human Research Program (HRP) Roadmap related to musculoskeletal disorder of crew health.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Development of a noninvasive diagnostic and treatment technology using noninvasive ultrasound with new crystal transducer technology will have a great potential to perform longitudinal measurement of bone alteration and prevent the risk of fracture.
Task Progress:	New project for FY2013.
Bibliography Type:	Description: (Last Updated: 02/17/2021)