Fiscal Year:	FY 2012	**Task Last Updated:**	FY 08/14/2012
PI Name:	Gernhardt, Michael Ph.D.		
Project Title:	Occupant Protection Data Mining and Modeling Project		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
Human Research Program Risks:	(1) **Dynamic Loads**:Risk of In-Mission Injury and Performance Decrements and Long-term Health Effects due to Dynamic Loads		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	Directed Research
Start Date:	06/20/2012	**End Date:**	06/30/2014
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:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
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Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Current National Aeronautics and Space Administration (NASA) Occupant Protection standards and requirements are based on extrapolations of biodynamic models, which were based on human tests performed during pre-Space Shuttle human flight programs. In these tests, occupants were in different suit and seat configurations than are expected for the Multi Purpose Crew Vehicle (MPCV) and Commercial Crew programs. As a result, there is limited statistical validity to the Occupant Protection standards. Furthermore, the current standards and requirements have not been validated in relevant spaceflight suit and seat configurations or expected loading conditions. To address the limitations of the current NASA standards, this study will address the following two objectives: 1) Develop a Finite Element (FE) model of Test device for Human Occupant Restraint (THOR) Anthropomorphic Test Device (ATD), and 2) Conduct data mining of existing human injury and response data using the THOR FE model. In order to develop updated standards, adequate injury assessment tools must be chosen and developed. In the case of dynamic loads, the THOR ATD was chosen as the appropriate human surrogate. For the data mining portion of the task, re-creation of the conditions of each impact case is needed to determine injury risk. Since physical re-creation of each case is not feasible, a numerical model of the THOR ATD is desired. An existing THOR FE model will be refined and validated. To supplement available THOR ATD validation data, additional THOR ATD testing will be conducted at two facilities and ATD response data will be collected. The FE model responses will then be assessed against the physical ATD responses. Once the ATD model is validated, it can be used for the data mining portion of the study. Because analogous space flight injury biomechanics data are very limited, data mining of other analogous environments will be used. These datasets are chosen as they have similarities with the landing environment expected in future vehicles. The existing human injury and response data from other sources include historical military volunteer testing, automotive Crash Injury Research Engineering Network (CIREN), IndyCar impacts, and NASCAR impacts. These data sources can allow better extrapolation of the ATD responses to off-nominal conditions above the nominal range that can safely be tested in humans. These elements will be used to develop injury risk functions for each of the injury metrics measured from the ATD. These risk functions would then be incorporated with the results of other Tasks to update the NASA standards. Task Description: The ultimate aim of this project is to develop Occupant Protection standards for NASA that would apply to all future crewed spacecraft. 1. Conduct ATD dynamic tests to relate human and ATD responses. 2. Mine existing human injury and tolerance data and simulate dynamic environments using Finite Element (FE) models. Relate human injury and responses to ATD estimated responses from FE models. 3. Develop injury risk functions based on ATD responses and develop NASA standards from these functions
Rationale for HRP Directed Research:	This research is directed because NASA must define complete scientific activities in a short time and there is insufficient time to issue a solicitation.
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2012.
Bibliography Type:	Description: (Last Updated: 10/31/2019)