Fiscal Year:	FY 2012	**Task Last Updated:**	FY 09/17/2013
PI Name:	Sandor, Aniko Ph.D.		
Project Title:	Assessment, Evaluation, and Development of Methodologies, Metrics and Tools Available for Use in Multi-agent (Human and Robotic) Teaming		
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) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
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		
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Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	09/07/2012	**End Date:**	09/30/2015
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:			
COI Name (Institution):	Cross, Ernest Ph.D. (Lockheed Martin/NASA Johnson Space Center) Chang, Mai Lee (NASA Johnson Space Center)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The study of human-robot interaction (HRI) involves understanding and shaping the interactions between humans and robots (Goodrich & Schultz, 2007). It is important to evaluate how the design of interfaces and command modalities affect the human's ability to perform tasks accurately, efficiently, and effectively (Crandall, Goodrich, Olsen Jr., & Nielsen, 2005). Many NASA robot systems are teleoperated. Developing safe, reliable, and effective human-robot interfaces for teleoperation involves providing the information necessary to support operator task performance. For robot navigation tasks, which include the operator moving a robot through space or commanding individual robot segments, the operator needs to understand the current and desired state of the robot, and have the most compatible command modality with the task. In Fiscal Year 2011 (FY11), preparatory work was completed in the form of literature reviews; observations of NASA robot systems; interviews with NASA robotic operators and trainers; and a space HRI workshop. These activities resulted in the selection of three research areas that are the focus of the proposed work. The three research areas are: Video Overlays, Camera Views, and Command Modalities. Studies proposed in this Directed Research Project in the area of Video Overlays consider two factors in the implementation of augmented reality (AR) for operator displays during teleoperation. The first of these factors is the type of navigational guidance provided by AR symbology. Participants' performance during teleoperation of a robot arm will be compared when they are provided with command-guidance symbology (i.e., directing the operator what commands to make) or situation-guidance symbology (i.e., providing natural cues so that the operator can infer what commands to make). The second factor to be considered for AR symbology is the effect of overlays that are either superimposed or integrated into the external view of the world. A study is proposed that compares the effects of superimposed and integrated overlays on operator task performance during teleoperated driving tasks. Studies proposed in the area of Camera Views investigate inclusion/exclusion of a robot within the video feed and camera frame of reference. One study will investigate the effects of including and excluding the robot's chassis within the video feed presented to operators on path-following and maze traversal task performance. Another study will investigate the effects of the addition of an exocentric camera frame of reference to egocentric frames of reference on operator task performance for these same tasks. Lastly, studies in the area of Command Modalities will systematically build and evaluate gesture and voice vocabularies for commanding a ground-based mobile robot. The first in this series of studies will have participants produce robot commands for a set of critical control functions. The characteristics of the commands will be analyzed. In a second phase of this study, the strength of association between command and voice/gesture inputs will be evaluated. The next two studies will test the learnability and memorability of the developed vocabularies in the context of a representative task.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2012. [Ed. note 9/17/13: added to Task Book when received information from HRP]
Bibliography Type:	Description: (Last Updated: 03/03/2016)