Fiscal Year:	FY 2023	**Task Last Updated:**	FY 05/13/2023
PI Name:	Valero-Cuevas, Francisco Ph.D.		
Project Title:	A Simple and Compact Countermeasure for Maintenance and Enhancement of Neuromuscular Control During Spaceflight		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Sensorimotor**:Risk of Altered Sensorimotor/Vestibular Function Impacting Critical Mission Tasks		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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PI Organization Type:	INDUSTRY	**Phone:**	323-423-0024
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PI Web Page:			
City:	La Crescenta	**State:**	CA
Zip Code:	91214-3516	**Congressional District:**	28
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2019 HERO 80JSC019N0001-FLAGSHIP & OMNIBUS: Human Research Program Crew Health. Appendix A&B
Start Date:	08/06/2020	**End Date:**	09/30/2027
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**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:**	NASA JSC
Contact Monitor:	Stenger, Michael	**Contact Phone:**	281-483-1311
Contact Email:	michael.b.stenger@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date changed to 09/30/2027 per V. Lehman/JSC (Ed., 6/21/23) NOTE: End date changed to 8/5/2022 per L. Barnes-Moten/JSC and NSSC information (Ed., 8/2/21)		
Key Personnel Changes/Previous PI:	July 2021 report: Dr. Emily Lawrence will act in the capacity of Consultant, re-designated from employee status. She remains integral part of the research effort and remains listed in the CoInvestigator field.		
COI Name (Institution):	Lawrence, Emily Ph.D. (CONSULTANT: Neuromuscular Dynamics, LLC)		
Grant/Contract No.:	80NSSC20K1585		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Sensorimotor control is vital for performance of mission-critical tasks in microgravity and on planetary and lunar surfaces. During the limited time available to them, astronauts rely on exercise to mitigate sensorimotor performance decrements during and after spaceflight. However, exercise mostly addresses decrements in strength and multi-joint coordination. Neuromuscular control enables dynamic interactions with the environment via fast subcortical responses. We propose that the patented Leg Dexterity System can uniquely enhance neuromuscular control and thus, greatly complement and amplify the efficacy of exercise as a countermeasure to neuromuscular performance decrements during and after spaceflight. In this project we will quantify dynamic stability and neuromuscular control before and after an 8-week strength and conditioning regimen (24 total training sessions) augmented with Leg Dexterity System training during each session. This ground-based demonstration of the efficacy of the Leg Dexterity System will motivate and justify spaceflight analog studies to evaluate its further development as a much-needed sensorimotor-based countermeasure. Multiple peer-reviewed successes support our fundamental claim that exposure to dynamic foot-ground interactions via the Leg Dexterity System will translate to improvement in sensorimotor control. Thus, we propose the Leg Dexterity System has reasonable and strong potential to serve as a training tool for sensorimotor control as per the following Hypotheses: Main Hypothesis: Supplementing an 8-week strength and conditioning regimen with the Leg Dexterity System increases dynamic stabilization and neuromuscular control abilities. Secondary Hypothesis: Despite the sex differences in dexterity levels we have reported in the past, there will be no sex difference in the amount of improvement in dynamic stabilization and neuromuscular control abilities. Deliverables: Scientific/Technical foundation for the simple and compact Leg Dexterity System at Countermeasure Readiness Level (CRL) 6. Human Research Roadmap Gap Addressed: SM-201:Development and ground testing of postural and locomotion countermeasures, including human factors aids (July 2020). [Previously CBS-SM28: Develop a sensorimotor countermeasure system integrated with current exercise modalities to mitigate performance decrements during and after spaceflight.] Our team consists of Dr. Valero-Cuevas (Principal Investigator) who is a professor of Biomedical Engineering and of Biokinesiology and Physical Therapy at the University of Southern California (USC) in Los Angeles, inventor of the Leg Dexterity System and Founder of Neuromuscular Dynamics, LLC. His PhD in Mechanical Engineering is from Stanford University. Dr. Emily Lawrence (Co-Investigator) has a PhD in Biomedical Engineering from USC, and is Researcher and Trainer at the Nike Sports Research Laboratory. Formerly, she was Director of Biomechanics at Sports Academy, and Research Engineering at the NASA Biomedical Research and Environmental Sciences Division. [Ed. note July 2021: Dr. Emily Lawrence will act in the capacity of Consultant, re-designated from employee status.]
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Testing whether dexterity can be trained will enable benefits to patients suffering from neuromuscular disabilities, and help train non-impaired individuals to enhance their neuromuscular ability.
Task Progress:	This is a supplemental progress report for the no-cost extension to allow us to submit and revise a manuscript (MS) to a peer-reviewed journal, and cover publication costs upon acceptance in late 2023. Since the last progress report was submitted in November 2022, we attended and presented at the 2023 Human Research Program Investigators' Workshop (HRP IWS 2023) from February 7, through Thursday, February 9, 2023. On the basis of the results presented at the HRP IWS, we are now applying for a supplement to participate in a head-down bedrest campaign in Germany. Our Goal is to add the Valero Dexterity Test® as a new horizontal leg dexterity assessment capability to the project "Countermeasures for Mitigation of Sensorimotor Decrements Following Head-Down Bed Rest" by Dr. Timothy R. Macaulay.
Bibliography Type:	Description: (Last Updated: 06/29/2023)
Abstracts for Journals and Proceedings	Lawrence EL, Valero-Cuevas EJ, Reid NK, Chen J, Koziol NA, Cohn BA, Valero-Cuevas FJ. "Training leg dexterity while seated enhances standing balance and postural control more than strength and endurance training alone." NASA Human Research Program Investigators' Workshop, Galveston, Texas, February 7-9, 2023. Abstracts. 2020 NASA Human Research Program Investigators' Workshop, Galveston, Texas, February 7-9, 2023. , Feb-2023