Fiscal Year:	FY 2022	**Task Last Updated:**	FY 02/04/2022
PI Name:	Willey, Jeffrey S. Ph.D.		
Project Title:	A Technology to Measure Gait, Egress, and Locomotor Performance in Perturbed Environmental Conditions After Simulated Spaceflight		
Division Name:	Space Biology		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	(1) Animal Biology: Vertebrate		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	jwilley@wakehealth.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	336-713-7637
Organization Name:	Wake Forest University		
PI Address 1:	Radiation Biology Section		
PI Address 2:	Medical Center Blvd, 4th Floor NRC Building		
PI Web Page:			
City:	Winston-Salem	**State:**	NC
Zip Code:	27157-0001	**Congressional District:**	5
Comments:	NOTE: PI formerly at Clemson University when NSBRI Postdoctoral Fellow Feb 2008-Oct 2010 (Ed., 12/18/2014)		
Project Type:	Ground,New Investigation	**Solicitation / Funding Source:**	2018 Space Biology (ROSBio) NNH18ZTT001N-FG2. App D: Flight and Ground Space Biology Research
Start Date:	02/01/2021	**End Date:**	01/31/2023
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	3	**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 ARC
Contact Monitor:	Loftus, David	**Contact Phone:**	650-604-1011
Contact Email:	david.j.loftus@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date changed to 01/31/2023 per NSSC information (Ed., 2/1/22).		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Danelson, Kerry Ph.D. (Wake Forest University)		
Grant/Contract No.:	80NSSC21K0294		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Long-duration spaceflight is challenging for the many body parts that help us maintain normal movements and perform well, which include our bones, joints, vision, and brain. Astronauts must perform to the best of their abilities when they are traveling to a destination like the Moon or Mars, and when they reach the destination. During the travel to the destination, or on the surface of the planet/moon, astronauts could face dangerous situations that require rapid escape movements, or situations where the body could be in peril due to surroundings (like when climbing the rough terrain of a mountain or into a valley). If an astronaut is not performing well due to altered visual performance, but also has damaged bones due to low gravity or radiation, the astronaut could be at risk of catastrophic joint tears or bone breaks while exploring uneven/dangerous terrains, or during a required rapid escape into or out of a spacecraft. Our laboratory has measured that performance is altered in rodents after ~35 days in orbit on the International Space Station. However, these measurements were taken on a treadmill moving forward at a constant speed. This does not represent the dangerous terrain of the Moon or Mars, or other rapid movements astronauts would face during spaceflight. Thus our intent is to develop and fabricate a method to better reflect locomotor performance in rodent models over uneven and dangerous lunar/Martian surfaces in order to best assess how combined spaceflight hazards (e.g, microgravity and radiation) cause deficits in astronaut performance, measure time to recovery, and identify countermeasures. We will create a platform on which sits our treadmill that can measure mouse and rat performance. However, the platform can move (one movable portion under each corner support of the treadmill) in a manner that can reflect uneven terrain or a rapid escape motion. Then we can measure how the animals that have previously been exposed to spaceflight conditions (like reduced gravity or radiation) respond. This platform and performance measurement device can then be used to test ways to maximize performance, and thus improve the technologies and approaches used during successful crewed space exploration.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This technology will permit us to measure how stability is affected after actual and simulated spaceflight, using rodents. Instability is a common biomedical problem that results from multiple conditions, including central nervous system diseases or injury, after orthopaedic procedures or injuries, after cancer treatment, among others. Maintaining stablilty while walking is essential for maintaining a patient's quality of life. Thus this technology will help us study the extent and mechanisms leading to instability in rodents models for these biomedical conditions, and then find ways to improve stability while walking or running.
Task Progress:	After crafting a wooden mock-up of the frame, we have constructed a universal joint adjunct frame that can hold the DigiGait and permit rotation of the unit, safely, about the pitch and roll axes. During the fabrication of the mock-up, we decided that a gyroscope design should be implemented for the final design. This would permit the motors to safely lift and move the DigiGait while preventing rollover. Our original plan was to implement a platform on which the DigiGait would sit that could be moved; however, it was realized that some exterior support (exoskeleton) would be required to both ensure safe movement and maximize angular rotation. The harness of the exoskeleton attaches under and to the DigiGait on each side by way of bolts through an aluminum plate at the base, then again with a threaded rod through the center with nuts on each side to prevent slipping. Mounted bearings with 1” diameter are bolted to each end of this harness for the first rotation or roll movement. There is padding between this harness and the DigiGait. The inner frame is a rectangle connected to both the harness and the load-supporting frame. The rotational accelerations about each axis are currently controlled by Two DC motors (24V, 41 Nm torque) to control rotation about each axis. Moreover, we created 3 different codes in MATLAB for frame movement, with the add-on for the Arduino Integrated Development Environment to control an Arduino Uno board with two BTS7960 motor drivers. Pulse width modulation (PWM) signals are sent to the DC motors to create displacements of the treadmill surface.
Bibliography Type:	Description: (Last Updated: 01/22/2025)