Fiscal Year:	FY 2020	**Task Last Updated:**	FY 07/23/2020
PI Name:	Giancardo, Luca Ph.D.		
Project Title:	Actionable Deep Space Stroke Detection with Deep Learning and Retinal Imaging		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	TRISH--TRISH		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	77030	**Congressional District:**	9
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2020 TRISH BRASH1901: Translational Research Institute for Space Health (TRISH) Biomedical Research Advances for Space Health
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Contact Monitor:		**Contact Phone:**	
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Key Personnel Changes/Previous PI:			
COI Name (Institution):	Channa, Roomasa M.D. (Baylor College of Medicine, Inc.) Sheth, Sunil M.D. (University of Texas Health McGovern Medical School)		
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Task Description:	An untreated stroke event would be destructive for a human deep space exploration mission. Increased cerebrovascular disease risk has been documented after prolonged exposures to ionizing radiations on Earth. Astronauts on deep space exploration missions will be exposed to galactic cosmic rays and solar particles for 30 months, which will lead to accelerated vascular injury likely increasing their risk of stroke, which is exacerbated by the negative effects of microgravity on cerebrovascular autoregulation. On Earth, acute strokes can be successfully treated with anticoagulant or thrombolytic drugs if the event is rapidly diagnosed and the type of stroke (ischemic versus hemorrhagic) is rapidly identified with Computer Tomography (CT) or Magnetic Resonance Imaging (MRI) brain imaging. However, these brain imaging capabilities do not exist in space and alternative robust means of diagnosing and classifying stroke are needed. Due to the homology between retinal and cerebral vessels, and the ease with which retinal images can be acquired non-invasively, retinal images have been studied as a marker for cerebrovascular events. We propose to use a combination of color fundus photos and Optical Coherence Tomography Angiography (OCT-A) images to identify stroke events and stroke type, effectively acting as a proxy for brain imaging. These imaging modalities are non-invasive and deployable in currently existing technologies for deep space missions. We will adapt our automated interpretable image-based deep learning algorithm to identify stroke and stroke type from retinal vascular images, enabling an automated life-saving tool usable on a deep space exploration mission. This approach will leverage the symmetry relationships between the retinal images of each eye in order to identify subtle vasculature changes and at the same time be robust to confounders that affect both eyes at the same time. Significance: If we were able to create a retinal imaging-based quantitative tool to establish the presence of stroke, and stroke type (ischemic versus hemorrhagic), we would be able to indicate the appropriate treatment in a deep space mission stroke emergency, when prompt intervention is of utmost importance in saving astronauts' lives. This is a high-risk high-reward project aiming to create and validate software prototypes towards this goal with a ground-based study which involves a data collection and algorithm development effort. The system proposed has the potential to enable lifesaving treatment in case of a stroke event. Innovation: - We will create an acute stroke database with subjects within a few hours of stroke onset and OCT-A imaging, in addition to neuroimaging, fundus retina images, and clinical assessment. - We will drive innovation by establishing the feasibility of machine learning models to identify acute stroke events and stroke type from retina data, effectively acting as a proxy for brain imaging. - We will be using a first-of-its-kind deep learning model using symmetry-sensitive relationships between the retinal images of each eye. This could enable the algorithm to be robust to space travel induced changes which affect both eyes at the same time, such as Spaceflight Associated Neuro-Ocular Syndrome (SANS). - Our model will be interpretable without having to compromise on specific architecture, as we will be able to study the regions of activation using the epsilon-LRP (Layer-wise Relevance Propagation) algorithm, to understand the image areas responsible for the model decisions. - While some initial work has been done to create machine learning models combining information from fundus images and OCT data, to our knowledge, we will be the first to experiment with a combination of fundus imaging and OCT-A imaging using machine learning approaches. Such combination will capture the optic disc/vasculature with a large field of view (fundus) and the finer information for blow flow (OCT-A).
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2020.
Bibliography Type:	Description: (Last Updated: 06/04/2024)