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FA4SANS-GAN: GENERATIVE AI TO UNDERSTAND OPHTHALMIC CHANGES IN SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS)

Abstract

Spaceflight associated neuro-ocular syndrome (SANS) occurs in astronauts following long-duration spaceflgith (LDSF) and is characterized by optic disc edema, posterior globe flattening and hyperopic shifs. Despite being a significant risk for the planned 2030 Mars mission, the underlying pathophysiology of SANS remains poorly understood. Multimodal imaging has provide significant insights into the structural changes occurring in SANS. These in-flight imaging studies include fundus photography, optical coherence tomography and orbital ultrasound. Post-flight fluorescein angiography images (FA) have also been performed and found the presence of choroidal folds. However this useful imaging modality is not available in-flight, due to weight and space constraints. Utilizing fundus photographs from the International Space Station (ISS), we introuduce a novel Generative Adversarial Network (GAN)-based architecture titled "FA4SANS-GAN". This GAN is capable of fundus-to-angiogram synthesis to help further define in-flight features of SANS. Our studies have shown FA4SANS-GAN retains clear biological markers, reduces acquisition noise, and provides overall improved performance when compared with 3 state-of-the-art GAN architectures; FA4SANS-GAN vs. Pix2PixHD (p ¡ 0.00001); vs. Pix2Pix (p ¡ 0.00001) vs. GANgio (p = 0.006).