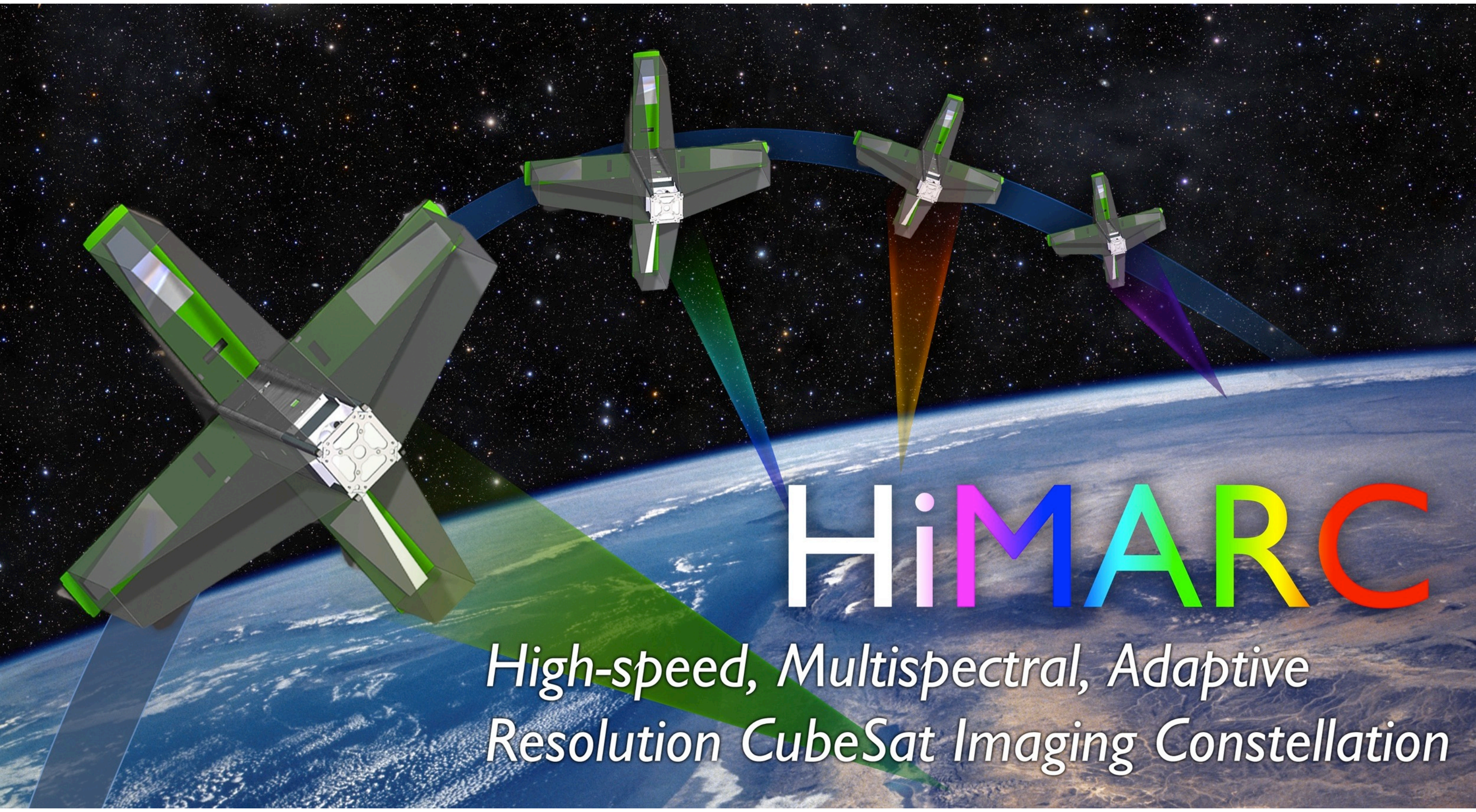
HiMARC Fluid Lensing – Using Fluid Perturbations as Optical Lens Elements

Ved Chirayath[†]
[†]*Stanford University Department of Aeronautics & Astronautics, Vedphoto. Stanford, California*
ved@stanford.edu



Abstract

HiMARC presents a novel, low-cost solution that addresses the fundamental aperture limitation of telescopes and CubeSat-based imagers while providing rapid, multispectral, high-resolution imaging capabilities for celestial and terrestrial targets using an uncoordinated array of sparse-aperture optical telescopes. In this paper, I focus on the theoretical and experimental developments of *Fluid Lensing* – one of the three main technological innovations behind the HiMARC concept.

I developed *Fluid Lensing* as a theoretical model for fluid-optical interactions in turbulent flows as well as two-fluid surface boundaries that, when coupled with lucky-imaging and a unique image-processing pipeline, may be used to significantly enhance the angular resolution of an optical system. Whereas existing adaptive-optics solutions view turbulent effects in the atmosphere as undesirable features that need be removed, I posit that turbulent eddies may be used as a synthetic aperture, effectively serving as a large-aperture refracting element in the telescope's optical path. Furthermore, perturbed two-fluid boundaries with different refractive indices, such as the surface between the ocean and air, may be used to similar effect in imaging targets on either side of the interface with enhanced angular resolution. I present encouraging preliminary experimental results from imaging the Venus transit event, deep space and planetary astronomical targets, a high-altitude balloon flight and underwater tests. The data seem to support my model and angular resolution estimates show at least diffraction-limited performance and, possibly, performance beyond the classical (Rayleigh) diffraction limit of the optical systems used. Visit www.vedphoto.com/himarc for more information.