1. Background

Fluid Lensing is a theoretical model and algorithm (Chirayath) for fluid-optical interactions in turbulent flows as well as two-fluid surface boundaries that, when coupled with computational imaging and an unique image-processing pipeline, may be used to not only remove strong optical distortions along the line of sight, but also significantly enhance the angular resolution of an otherwise underpowered optical system. In addition to marine targets, *Fluid-Lensing* has shown applicability to imaging targets through the turbulent atmosphere at high resolution, which also applies to imaging targets from LEO or a UAV platform at a ground sample distance approaching the cm-scale. Such a capability may enable novel Earth Science remote sensing capabilities. Unfortunately, current airborne and spaceborne sensors lack the design specifications that *Fluid-Lensing* requires by a large margin. Namely, a high-frame-rate uncompressed video capture ability of at least a 2K (2000 x 2000 pixel) array running at 90 frames per second with a powerful x86-based onboard processor and SSD hard drive.

2. Specifications

The vendor is responsible for providing the CubeSat chassis, developing and manufacturing an integrated, functioning payload that works as a standalone video capture device integrating the supplied imaging payload. The effort will culminate in a laboratory-tested integrated CubeSat imaging payload capable of the minimum *Fluid-Lensing* performance requirements, listed in *Specifications*, which can later serve as a universal imaging payload for a 3U CubeSat architecture.

Fluid Lensing Airborne and Spaceborne Imager Minimum Technical Requirements
Payload & bus

3.1 - 1500cc, 1.5kg mass in a 1.5U CubeSat form factor (maximum size and mass)
  3.1A - External user interface for imager control and data management
3.2 - Autonomous video capture capability with adjustable focus, bitrate, framerate, compression type and region of interest
3.3 - Passive, non-convective cooling design
3.4 - Shake and bake certify components and test results
3.5 - Vibrational tolerance while in operation
3.6 - Vacuum test components and test results
3.7 - Aerial gimbal mount threading for UAV integration

3.8 - **Integrated computing platform specifications -** 4-18V operating voltage, 35W maximum peak load
  3.8A - 1.2GHz Intel® Core Duo® processor
  3.8B - 2GB RAM & 500GB SSD
  3.8C - 16GB boot flash disk
  3.8D - USB 3.0 and SATA II interfaces, for > 2Gbps throughput minimum
  3.8E - Gigabit Ethernet, serial, USB interfaces
  3.8F - Windows® and Linux-compatible

The items below (3.9) are supplied by the Government.

3.9 - Integrated imaging payload specifications - Payload is designed to be integrated into future 3U CubeSat bus architecture and as UAV payload

3.9A - High-performance camera that accepts range of Leica® M-mount lenses from 20-600 mm focal length aspherical and catadioptric lenses

3.9B - 1” size color or monochrome CMOS or CCD imager with global shutter and RAW output

3.9C - 2048x2048 @ 90fps minimum bandwidth at 3Gbps over USB 3.0 Superspeed

3.9D - Selectable bit depths, auto-exposure, configurable region of interest and variable frame rate

3. Deliverables

The vendor shall design and deliver two functioning space-capable 1.5U integrated CubeSat-platform-based imaging payloads that that record uncompressed high-frame-rate videos to a solid state disk array over an x86-based chipset and meet the minimum 2 Gbps high-bandwidth and integrated CPU and storage requirements for 3D imaging at high-resolution with *Fluid-Lensing.*

Prototype Unit 1 shall be delivered to NASA Ames Research Center within ninety days from date of award. Unit 1 shall undergo laboratory testing, compatibility validation and final design review by the NASA Ames Research Center Principle Investigator.

Unit 2 shall be delivered to NASA Ames Research Center no later than 21 days from date of acceptance of Unit 1.

Documentation and support software, engineering, consultation and test services shall be provided biweekly during the manufacture of the units and for one year after final deliverable date to the NASA Ames Research Center Principle Investigator.