

1. **Research Title:** "Use of Flash LADAR for Aiding of Low-Cost IMU Navigator on Loitering Aerial Vehicles."

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Electrical Engineering and Computer Science / Vehicle Guidance, Navigation, and Control (MS or Ph.D. level)

4. **Description:** Flash LADAR (Laser Radar) technology consists of a relatively wide angle modulated laser emitter coupled with a focal plane array detector to create an "image" where each pixel contains range and intensity information. Coupling Flash LADAR information with position and attitude information allows for 3-D scene recreation. With the recent development of low-cost (<\$10 k) Flash LADAR technology, the use of such technology to aid a low-cost Inertial Measurement Unit (IMU) has become practical and of great interest. Current low-cost Flash LADAR technology is capable of greater than 100 x 100 pixel resolution with 5 mm depth resolution at a 30 Hz frame rate.

This research will focus on the integration of Flash LADAR data with a lowcost IMU to provide a stable navigation solution for a loitering air vehicle - such as the DARPA funded OAV platform. Part of this research includes determining the minimum IMU quality necessary to develop a stable (non-diverging) navigator. Also of great interest in this research are the positioning accuracy and attitude accuracy of such a system. This research would also include the development of either, an operating Flash LADAR / Low-Cost IMU data collection system, or a Flash LADAR / Low-Cost IMU system simulator with preference given to the former.

The demonstration of the Flash LADAR / IMU Navigator on an actual aerial vehicle is not a required part of this research, and there is no requirement for the development of a real-time system.

5. **Objectives:**

- a. Create a Flash LADAR / Low-Cost IMU system simulator
- b. Develop a Flash LADAR / Low-Cost IMU data collection system
- c. Identify measurements which can be extracted from Flash LADAR data (e.g. surfaces, edges, corners, etc.) which are useful in the aiding of a low-cost IMU Navigator
- d. Evaluate the statistical characteristics of the above mentioned measurements and determine the minimum quality IMU necessary for stable system operation
- e. Develop a navigation algorithm which provides relative position and attitude information with respect to an initialized state

6. **Research Classification/Restrictions:** None at this time.

7. **Eligible Institutions:** DAGSI

