# Defining Handling Qualities of Unmanned Aerial Systems, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

## ABSTRACT

Unmanned Air Systems (UAS) are here to stay and operators are demanding access to the National Airspace System (NAS) for a wide variety of missions. This includes a proliferation of small UAS that will operate beyond line of sight at altitudes of 500 feet and below. A myriad of issues continues to slow the development of verification, validation, and certification methods that will enable the safe introduction of UAS to the NAS. These issues include the lack of both a consensus UAS categorization process and quantitative certification requirements including the definition of UAS handling qualities. Because of a lack of quantitative data, attempts to address core problems thus far have failed to achieve consensus support. Currently the UAS arena includes traditional airframers, established UAS manufacturers, academic institutions, and many newcomers such as Amazon, Google, and Facebook that see UAS as a means to other commercial ends. The program described herein does not propose to address the entire verification, validation, and certification problem, but instead to address the important need to define UAS handling qualities in both remotely piloted and autonomous operations with an end product being the UAS Handling Qualities Assessment Software System, a toolbox that will guide UAS stakeholders through a systematic evaluation process. The process begins with classification. Because of the wide variety of vehicle types and size there cannot be a one-size-fits-all set of requirements. Given an appropriate classification, missions are next considered wherein they are broken down into specific task elements. These mission task elements are then used to identify specific criteria that predict handling qualities analytically and test demonstration maneuvers that verify handling qualities in flight. Feasibility of this process will be demonstrated in Phase I with existing physics-based UAS analytical models and flight test data.

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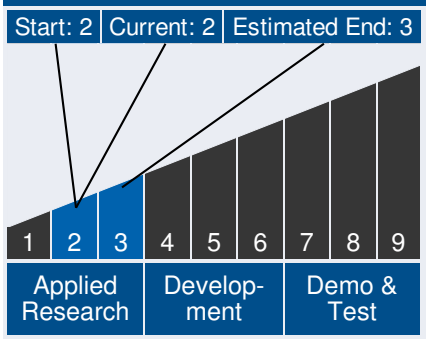
### Technology Maturity




### Management Team

**Program Executives:**

- Joseph Grant
- Laguduva Kubendran

**Program Manager:**

- Carlos Torrez

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## ANTICIPATED BENEFITS

### To NASA funded missions:

Potential NASA Commercial Applications: First, this proposal directly supports the NASA Air Vehicle Technology topic that 'solicits tools, technologies and capabilities to facilitate assessment of new vehicle designs and their potential performance characteristics' and as specifically called out under Topic A1.05 Physics-Based Computational Tools - Stability and Control/High Lift Design Tools, the 'definition of handling qualities for unmanned aerial systems.' Beyond these specific NASA goals, NASA issued in 2014 a new strategic vision for the Aeronautics Research Mission Directorate (ARMD). From this effort came six new strategic thrusts. Of these thrusts, several involve the safe expansion of global air operations and are therefore directly related to the safe integration of UAS into the air space. The specific thrusts include 'safe, efficient growth in global operations,' 'real-time, system-wide safety assurance,' and 'assured autonomy for aviation transformation.' This proposal also supports NASA's Integrated Aviation Systems Program (IASP) of which the UAS Integration in the National Airspace System (NAS) Project is a direct application.

### To the commercial space industry:

Potential Non-NASA Commercial Applications: In describing the growing UAS market, Teal Group reported that the worldwide UAS market spending will increase from $6.4 billion in 2014 to $11.5 billion in 2024. The Teal Group article also states that 'Our 2014 UAV study calculates the UAV market at 89% military, 11% civil cumulative for the decade, with the numbers shifting to 86% military and 14% civil by the end of the 10-year forecast.' The STI-Mitchell Aerospace Research team sees a strong demand for the advancement of UAS handling qualities capability on the military side where the Air Force and Navy have long been looking for a path forward in this area. The team sees this demand expanding to the growing commercial market, particularly on the small UAS side, as the FAA continues to open

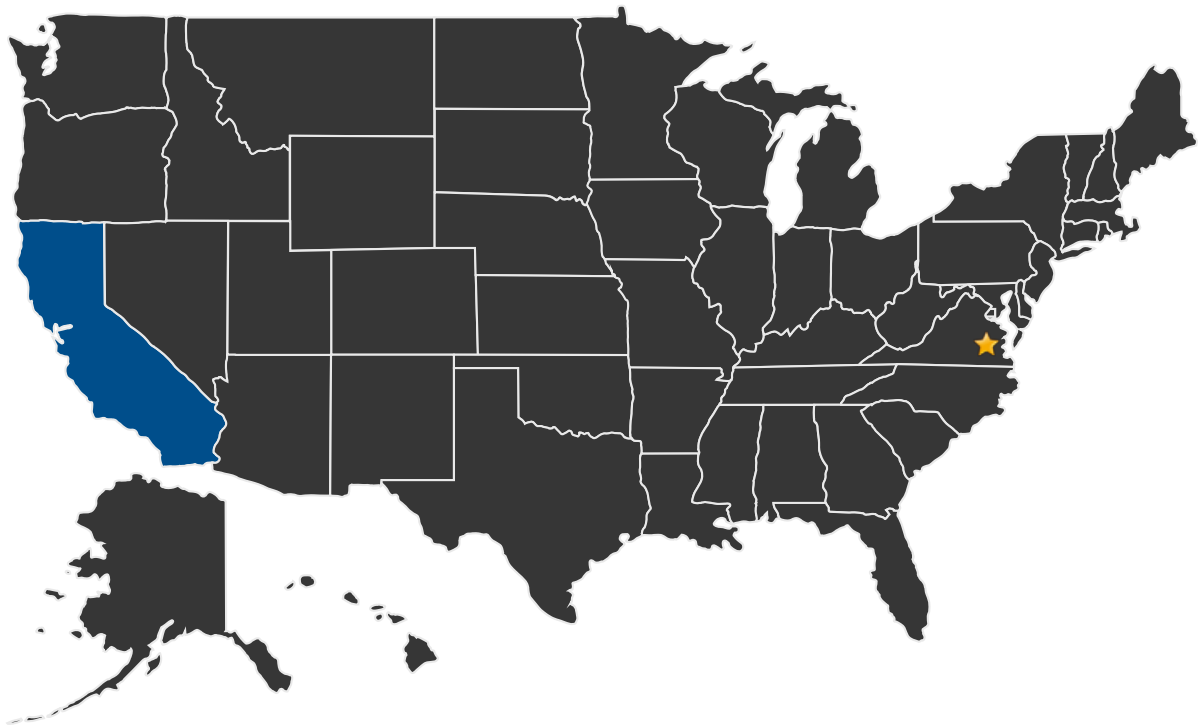
**Management Team *(cont.)***

**Principal Investigator:**

- David Klyde

up the NAS to new UAS applications over the coming months and years.

## U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

**Lead Center:**
Langley Research Center

**Other Organizations Performing Work:**

- Systems Technology, Inc. (Hawthorne, CA)

## PROJECT LIBRARY

**Presentations**

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23514)

## IMAGE GALLERY

*Defining Handling Qualities of Unmanned Aerial Systems, Phase I*

## DETAILS FOR TECHNOLOGY 1

### Technology Title

Defining Handling Qualities of Unmanned Aerial Systems, Phase I

### Potential Applications

First, this proposal directly supports the NASA Air Vehicle Technology topic that 'solicits tools, technologies and capabilities to facilitate assessment of new vehicle designs and their potential performance characteristics' and as specifically called out under Topic A1.05 Physics-Based Computational Tools - Stability and Control/High Lift Design Tools, the 'definition of handling qualities for unmanned aerial systems.' Beyond these specific NASA goals, NASA issued in 2014 a new strategic vision for the Aeronautics Research Mission Directorate (ARMD). From this effort came six new strategic thrusts. Of these thrusts, several involve the safe expansion of global air operations and are therefore directly related to the safe integration of UAS into the air space. The specific thrusts include 'safe, efficient growth in global operations,' 'real-time, system-wide safety assurance,' and 'assured autonomy for aviation transformation.' This proposal also supports NASA's Integrated Aviation Systems Program (IASP) of which the UAS Integration in the National Airspace System (NAS) Project is a direct application.