NASA Ames UAS Program Overview

- **Ames Unmanned Aerial Systems Focuses in Support of Airborne Science Program**
  - Mission Support
  - Aircraft inventory upgrades and replacements
  - Autonomous Technology Development
  - UAS National Airspace Operations Development
- **Primary Inventories small and mid size UASs**
  - Dragon Eyes
  - SIERRA Ship B, Viking 400s
- **Partnerships**
  - Agencies and Institutions
    - Forest Service, California Emergency Services, NOAA, FAA
  - University of California, UAV Collaborative, commercial UAS operators

NASA Ames UAS Program Overview

- **SIERRA Ship B Development and Upgrades**
  - Structural upgrade, remanufacture airframe, carbon fiber
  - Upgraded landing gear
  - New engine, higher hour power
  - Wet wing, higher fuel capacity

- **Viking 400s**
  - Training and certification
  - Establishing East/West Coast Flight Teams
    - Wallops and Ames
    - Auto pilot change to Piccolos'

Distributed Swarm Autonomy for Scientific Investigation of Erupting Volcanic Systems

C Ippolito, M Fladeland, R Berthold, R Kolyer, B Storms (NASA/ARC), G Bland (NASA/WFF), D Pieri (JPL)

Problem

NASA ES&I focus area has identified a chronic and pervasive lack of in situ data near active volcanic systems which is hindering scientific advancement. Unfortunately, state-of-the-art UAS autonomy does not permit safe operations near volcanic eruptions, where the environment is chaotic, uncertain, time-varying, and hazardous.

Approach

- Utilize advanced autonomy to enable intelligent distributed UAS sensing swarms that maximize scientific data return around active erupting volcano systems.
- Autonomously coordinate and adapt to changing conditions
- Allow vehicles to safely navigate in-and-around the chaotic time-varying phenomena (aerosol plume, ash clouds, complex wind vector field)
- See-and-avoid the volcanic system and environmental hazards
- Communicate and share real-time data between vehicles
- Build a shared real-time model of the volcanic system

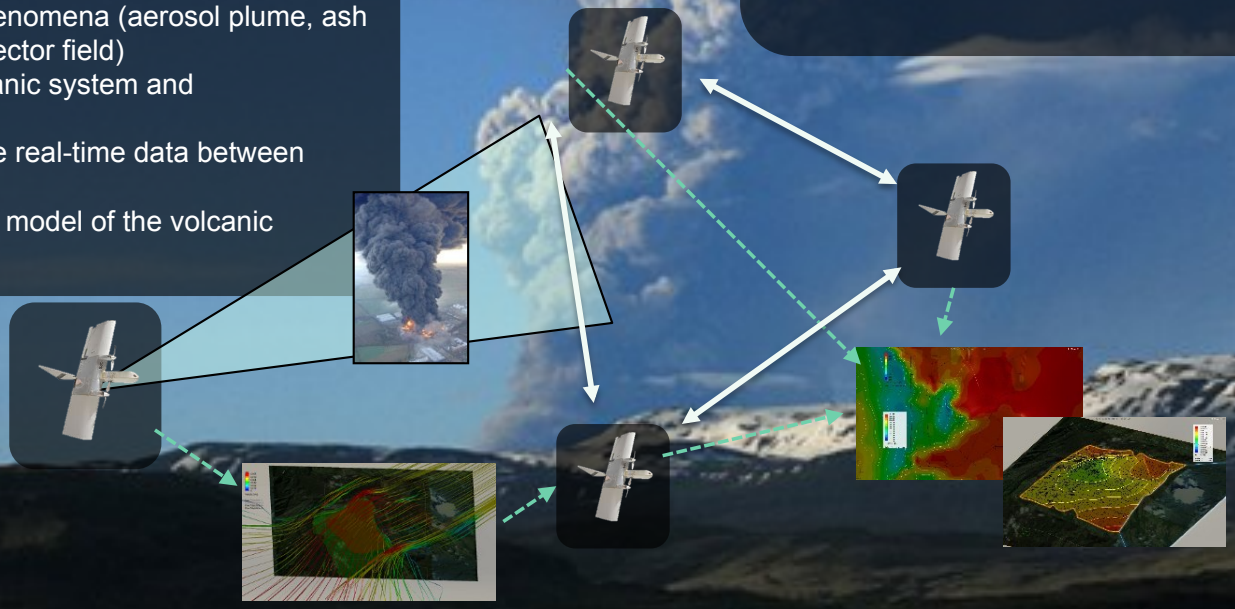
Intelligent Autonomy Research Technologies

1. Large-scale modeling for autonomy. Probabilistic computational fluid dynamic models generate a priori beliefs of the 'global' volcanic system evolution.

2. Real-time mapping with distributed estimation. Model-based processing pipeline generate 'global' predictions of the volcanic system based on distributed 'local' sensor observations.

3. Adaptive airborne wireless mesh networking. Allows timely communication and coordination.

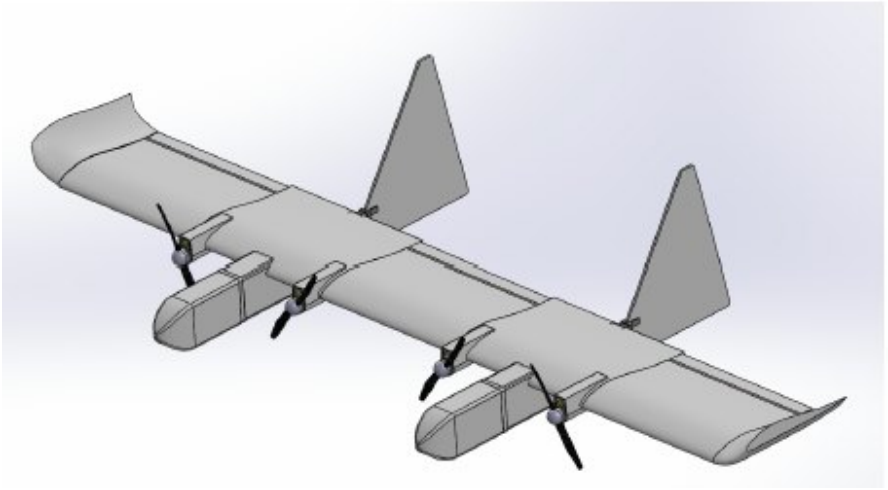
4. Onboard payload-directed flight control. Vehicles utilize distributed model for planning. Advanced flight control systems analyze and optimize sensor return by adjusting aircraft flight.



FrankenEye Unmanned Aerial Systems (UAS) Challenge

Use of 3D Printing and Rapid Prototyping To Optimize UAS To Mission Requirements

Center of Innovation Fund (CIF), Project



May 21, 2014

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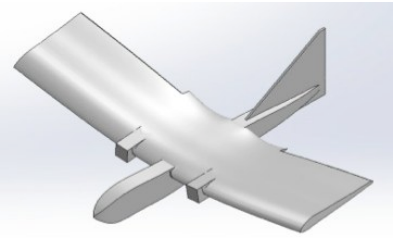
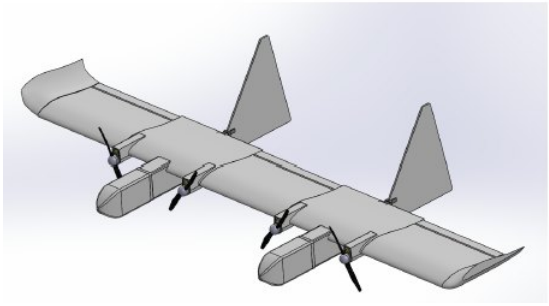
Rapid Design to Mission Requirements



Dragon Fly

Increase flight time by 20%

Wing Span: 70 in
Wing Chord: 12 in
Operational Weight: 6 lbs
Payload Weight: ~2 lb
Cruise Speed: 30 kts
Altitude: 10,000-30,000 ft



Dragon Lifter

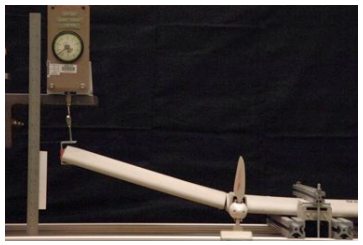
Increase payload weight by 30%

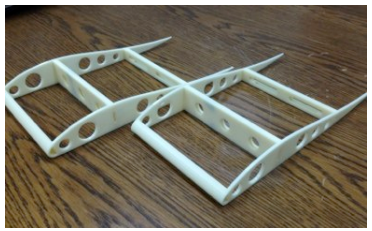
Wing Span: 78 in
Wing Chord: 12 in
Operational Weight: 11.5 lbs
Payload Weight: ~5 lb
Cruise Speed: 30 kts
Altitude: 30,000-65,000 ft

Design, Manufacturing, and Assembly Process
(Less than $50K per aircraft)

Rapid Prototyping/Testing

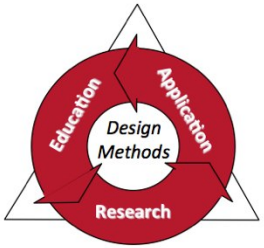
Fail Early, Fast, and Often

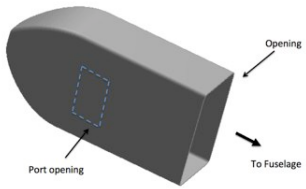


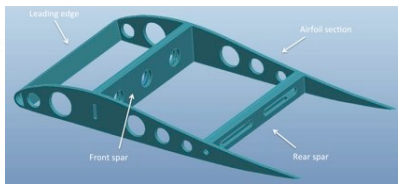


Design for Manufacturing

Reduce Manufacturing Time

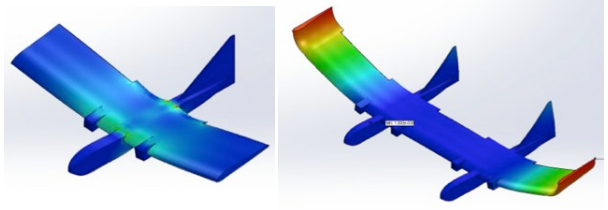


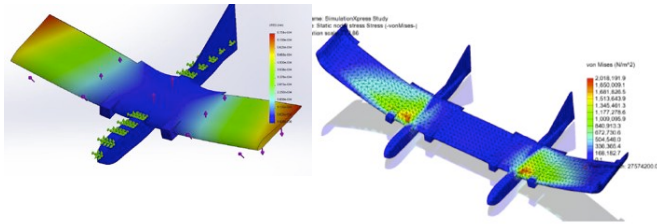




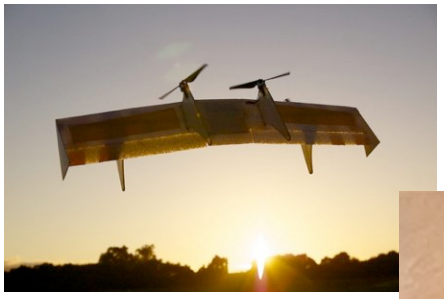
Design, Modeling, and Simulation

Aero-Propulsive Elastic Modeling





What We Plan to Demonstrate…



Vertical Takeoff

Rapid Manufacturing

Formation Flying

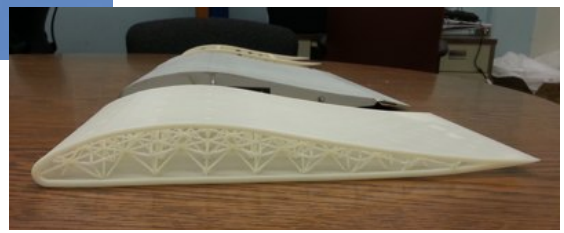
Improved Endurance

Expendable Aircraft

More Sensors

High Lift Systems

Modularity of Parts



Microwave Repowering

High Strength-to-Weight

Partnerships/Collaborations

Partnerships Being Leveraged

- Stanford DFM Group
- Stanford UAV Group
- NASA Ames Space Shop
- UC Santa Cruz UARC
- University of Colorado Boulder
- US Coast Guard/Google Ocean
- University of Nevada/DRI/Fireball

Partnerships Under Development

- DARPA
- NPS/ONR/NOAA
- USDA Forest Service
- US Fish and Wildlife Service
- Stanford Robotics Group
- American Geophysical Union
- Univ. of Colorado Reno

Academia

Industry

Government