COE CST First Annual Technical Meeting:

Autonomous Rendezvous & Docking

Penina Axelrad

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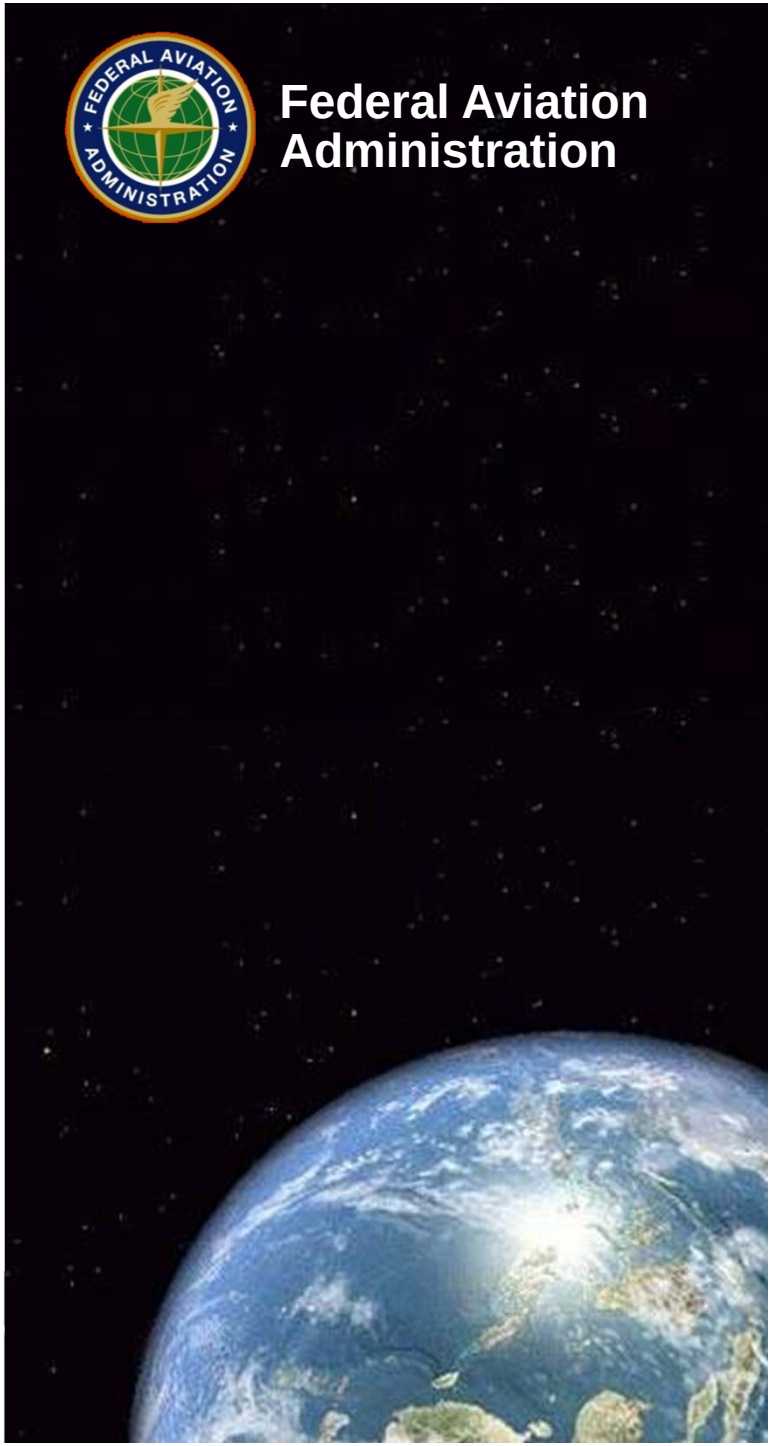

Overview

- Team Members
- Purpose of Task
- Research Methodology
- Results or Schedule & Milestones
- Next Steps
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AR&D Team

- CU – Basis for requirements, standards and methods
- Florida State – Approach trajectories
- Stanford – Target pose and shape sensing
- U of Florida – Post capture operations

- Identifying and addressing key technology gaps

Team Members

Current

- Penina Axelrad, CU
- Holly Borowski, PhD Student, CU, Aerospace Engineering Sciences (Summer 2011)

+ Planned

- Draper Lab, Ball Aerospace, LMCO
- Stanford (Todd Walter)
- IIT (Boris Pervan)

Purpose of Task

- **Purpose** – Develop a framework to enable licensing of multiple vendor vehicle systems that will make LEO orbital rendezvous and docking a routine and safe activity.
- **Objectives** – Define requirements and identify critical safety and technological issues for each phase of AR&D timeline; identify technology gaps and viable system alternatives
- **Goals** – Construct a draft basis for standards for AR&D of vehicles in LEO encompassing approach trajectories, sensing, estimation, guidance and control, human interaction, and reliability.

Research Methodology

First year is a small-scale ($17K) effort to construct a roadmap for the overall project

- Review relevant aspects of the state-of-the-art in LEO rendezvous and docking, UAV formation flying and mid-air refueling, aircraft landing
- Establish AR&D mission phases and classes of requirements and risks for each
- Identify critical systems, technologies, and concepts required
- Organize and plan research tasks that will lead to comprehensive basis for standards at the end of 5 years

Roadmap for Commercial LEO AR&D

- Identify stages, requirements & risks for commercial LEO AR&D
- Evaluate the maturity of key technologies
- Develop requirements flow down (technology pull)
- Look at promising technologies that can enhance performance, safety, robustness, reliability (technology push)
- Identify connections to other FAA activities including aircraft collision avoidance, UAV flight rules, mid-air refueling, and space situational awareness
- Draft plan for bringing the pieces together over a 5 year period to form the basis for standards development

AR&D Phases & Technologies

AR&D Phases

- Phasing (>5 km)
- Homing
- Closing (few km to 250m)
- Final approach (<250m)
- Docking (vehicle dimension)

AR&D Technologies

•Sensors and algorithms

•Guidance and control algorithms and actuators

•Software – real-time onboard mission manager and flight software

•Docking/capture systems

Commercial, LEO AR&D considerations

- Manned or unmanned
- Automated or autonomous
- Target geometry known or unknown
- Target cooperative or non-cooperative
- Target attitude controlled or uncontrolled
- Number of vehicles - two or more
- Duration – long (multi-orbit) or short

Results or Schedule/Milestones

- Initial literature search completed, summary of existing AR&D approaches compiled.
- Key mission phases defined and relevant technology elements and some risks for each identified.
- Met with potential industrial collaborators from Ball Aerospace who provided information on sensor development and experiments.

Next Steps

- Coordinate with COE partners
- Meet with other industrial potential partners
- Develop draft roadmap and proposal for 3 year project

Contact Information

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