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Prognostics As-A-Service (PaaS)

National Aeronautics and Space Administration

Is it feasible to provide wide access to failure prediction (prognostics) information to improve decision-making capabilities for UAM through a cloud-enhanced service?

Overview/Description

Deep awareness of aircraft system health-state is critical for maintaining safe, efficient growth in global operations and enabling autonomy. Maintainers, operators, controllers, dispatchers, pilots, and autonomous systems must have reliable real-time predictions of vehicle health to preserve safety and efficiency.

We will explore the feasibility and challenges of cloud-enhanced prognostics. Aircraft request PaaS in flight to supplement onboard systems or provide complete health awareness. We will explore and demonstrate the ability to address six major challenges of PaaS: Generality, Environmental Complexity, Utility, Trust, Communications, and Security. We will also explore the factors in the decision to host prognostics onboard vs As-A-Service.

Feasibility Assessment

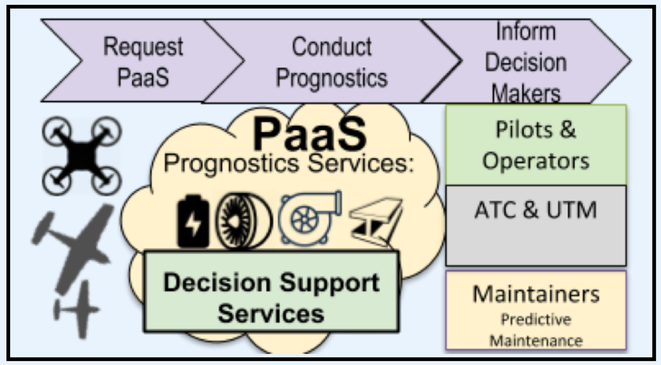
- Demonstrate capability to provide prognostics to real-time decision makers in time to prevent failure of critical systems.
- Demonstrate capability to provide prognostics to non-real-time decision makers in time to provide multiple decision choices (an optimization opportunity)

Benefit if Feasible

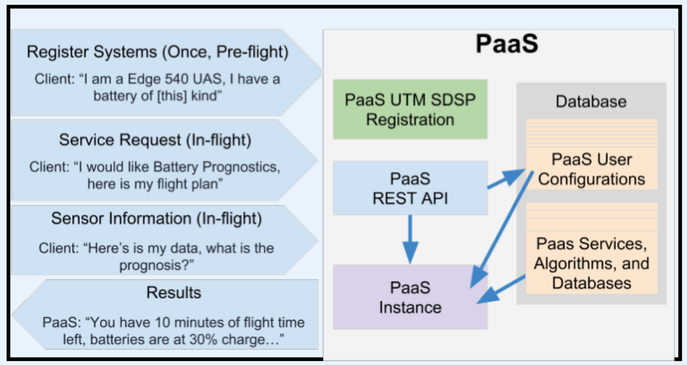
- Wider access to precise near real-time prognostics (which often cannot be produced on-board to the required quality) for real-time decision makers (e.g., operators, pilots, autonomy) to prevent critical in-flight failures
- Wider access to prognostics for long-term planning to optimize decision making (e.g., maintenance scheduling) to reduce operational costs
- Reduced state of health estimate uncertainty, higher system coverage, and improved decision-making due to increased resources available on cloud-enhanced architecture vs onboard

Partners

- PaaS Advisory Working Group, Advise on the identification of feasibility challenges, opportunities for engagement with industry, and on how feasibility can be established in a manner meaningful to academia. Currently there are 34 members.
- Working closely with team in the UTM and SWS Projects
- Key partners at AFRC, ARC, GRC, and LaRC,



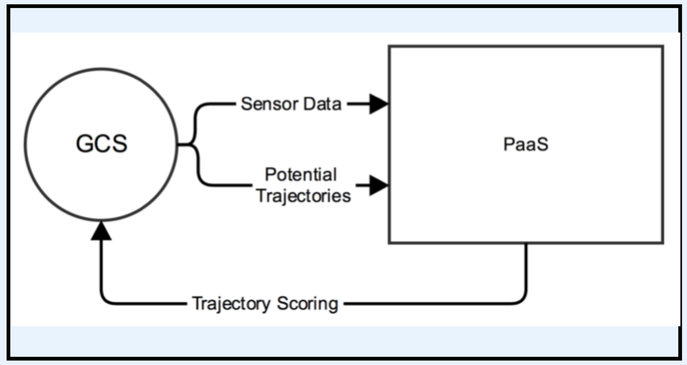
General PaaS Concept



Architecture of PaaS Prototype System

Generalization	Can a single PaaS system support the wide variety of aircraft classes and configurations?
Env Complexity	Can a PaaS system provide accurate predictions in complex environments?
Utility	Can the PaaS results be provided in such a way that they can inform significant action to maintain safety and efficiency?
Security	Can **existing security solutions** help PaaS operate in a way so as to protect Confidentiality, Integrity, and Availability?
Comms	Can PaaS handle the communication complexity involved with the architecture: including bandwidth constraints, dropout, etc.?
Trust	Can PaaS be designed so that the results will be trusted?

The six identified feasibility challenges



UTM-relevant trajectory scoring flight scenario: trajectories are scored by PaaS according to "probability of mission success" and state is estimated from provided sensor data

Recent Results / Status

1. Created PaaS prototype with battery discharge prediction capabilities and started testing with real flight data
2. Explored and identified details of size primary feasibility challenges: Generality, Utility, Communications, Security, Environmental Complexity, and Trust
3. Formulated PaaS Advisory Working Group
4. Integrated PaaS for UTM-relevant flight demonstration scenario

Next Steps

1. [November, 2018] Demonstration with UTM-relevant flight scenario
2. Explore quantification of prognostics accuracy and timeliness requirements for decision makers
3. Explore advanced computing (e.g., GPU) to meet the requirements identified in step 2
4. Release of PaaS Software Prototype
5. Integration with ATM-X testbed and ATM-X-relevant demonstration
6. Explore PaaS performance in and solutions for Communication Constrained and Denied Environments
7. Explore utility for UAM Operations in coordination with UCAT team, including expanding to additional systems (Motors, ESC)
8. Explore utility for Autonomous Contingency Management with TTT-AS Subproject

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