CPS: Breakthrough: Solar-powered, Long-endurance UAV for Real-time Onboard Data Processing

PI: Marco Caccamo

University of Illinois at Urbana-Champaign

http://pertsserver.cs.uiuc.edu/~mcaccamo/

Email: mcaccamo@illinois.edu

Award Number: CNS-1646383

Description

- **Goal**: design a long-endurance, solar-powered UAV for high performance RT computing

➔ **Computing centric design**: low weight, low power sailplane with high performance SoC

➔ **<u>Challenges</u>**: 1) design a system-wide and adaptive power manager that is maneuver-aware and task aware; 2) design a power-aware Integrated Modular Avionics (IMA) for multi-core platforms

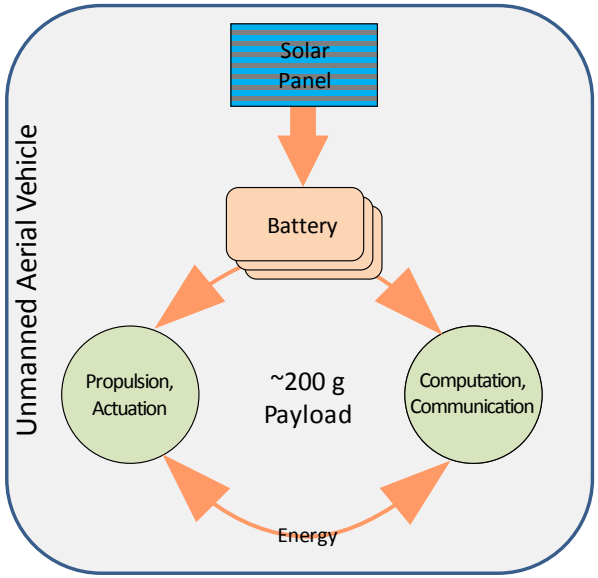
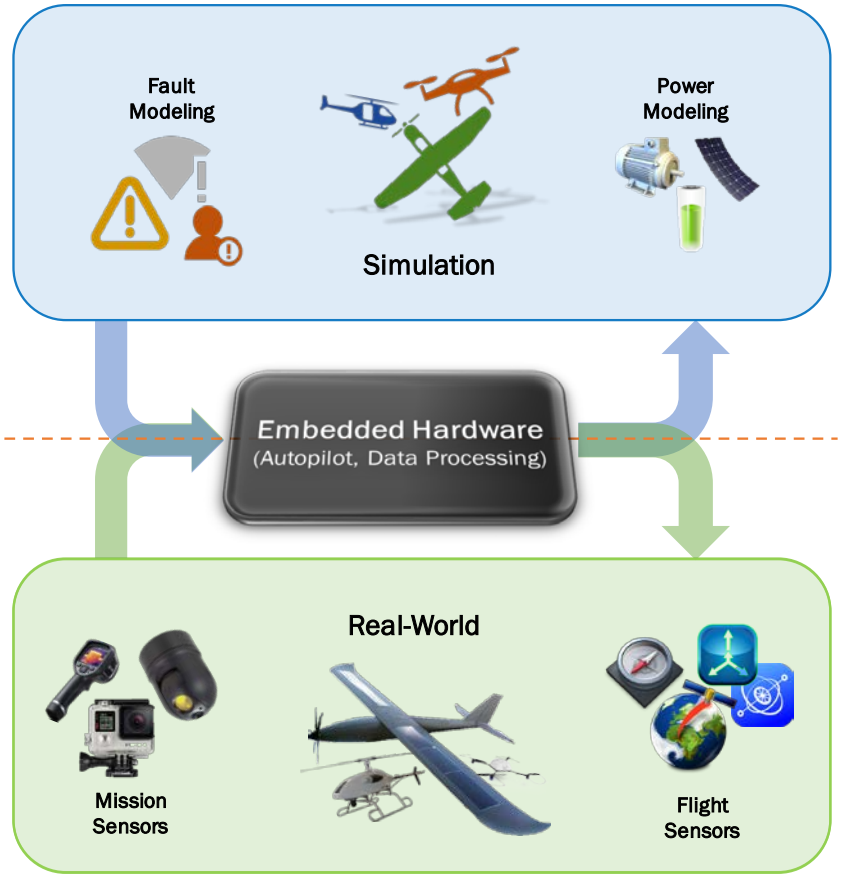


Figure 1: Energy diagram of proposed unmanned aircraft

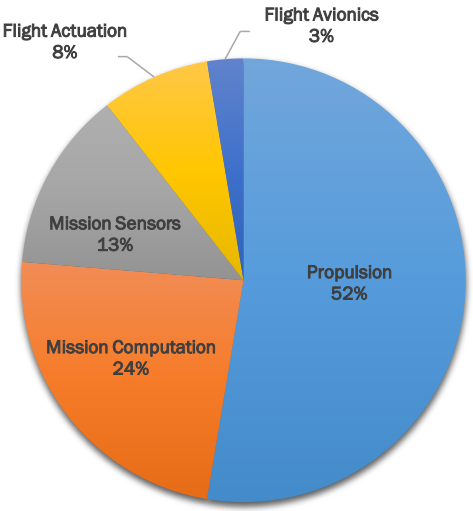
Figure 2: A photo of the Esprit Models Pulsar 3E FPV

Findings

Emulation Environment (UAV-EE): it is not only able to combine several different simulations (flight, power, failure, etc.) but further it emulates the interface to the embedded hardware.



POWER MODELING: The presented power model focuses on the propulsion power (in a light-weight and small sailplane, it constitutes approximately 50% of the total power consumption).



Propulsion Power Modeling

$$P_{ss} = \frac{gm|\vec{v}|}{C_{LD}} \frac{\cos\gamma + C_{LD}\sin\gamma}{\cos\phi}$$

$$P_{dyn} = m(\vec{v} \cdot \vec{a})$$

$$P_{propulsion} = \frac{P_{ss} + P_{dyn}}{\eta_m \eta_p}$$

g, m, C_{LD}	gravity, mass, aerodyn. coefficient
$\vec{v}, \vec{a}$	velocity, acceleration
γ, ϕ	climb and roll angle
η_m, η_p	motor and propeller efficiency

Submitted to ICCPS'18: M. Theile, O. Dantsker, D. Amir, R. Nai, and M. Caccamo, "Power-Aware Emulation Environment for Design and Testing of Unmanned Aircraft Avionics"

Evaluation

Experimental Hardware:

- RC Trainer
- 1.4m Wingspan
- 3.92kg Mass
- Al Volo AP-DAQ Board
- Xsens Mti-G-700 IMU + GPS