MulBERRY: Enabling Bit-Error Robustness for Energy-Efficient Multi-Agent Autonomous Systems

Session 8D (Wed 10:00-11:15am)

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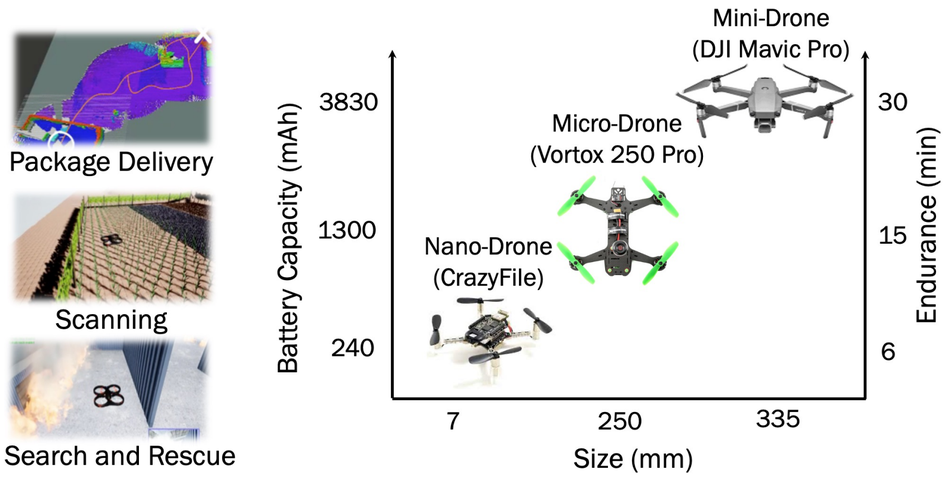
Paper Webpage

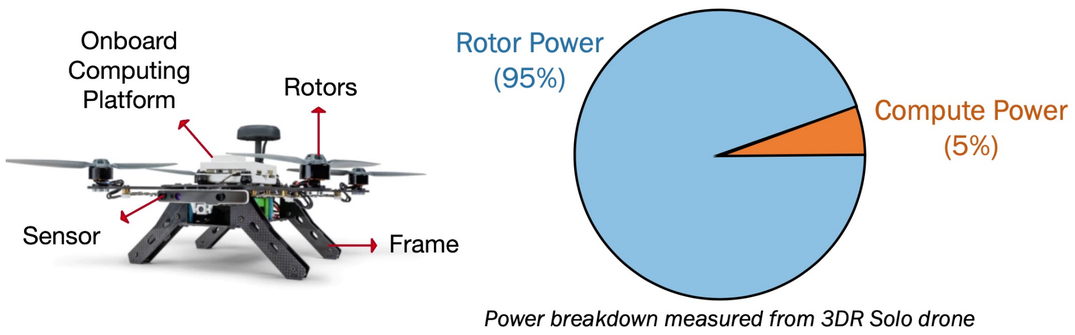
Motivation, Challenges and Goal

❖ **Efficient and Resilient Autonomous Swarms** is essential for diverse application scenarios.

✓ Challenge 1: distributed resource-constrained nodes.

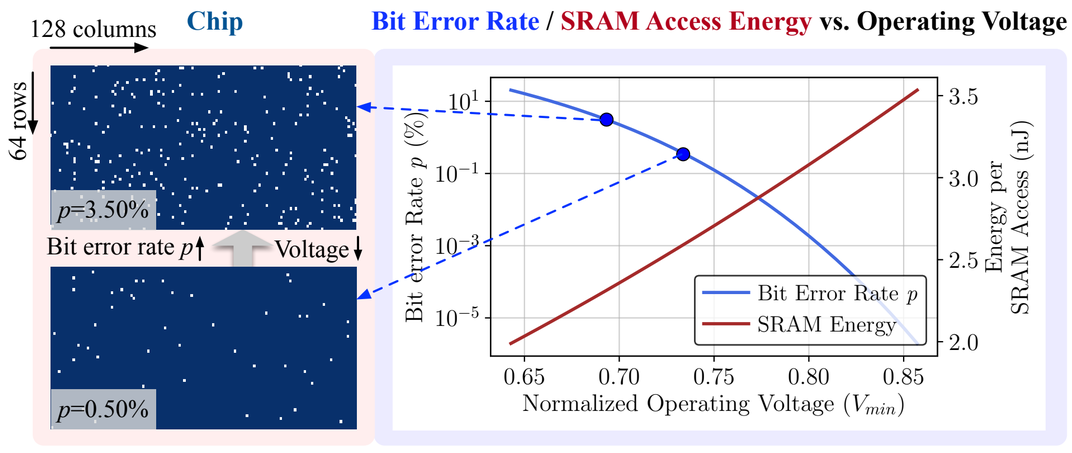


✓ Challenge 2: complex cyber-physical UAV systems.

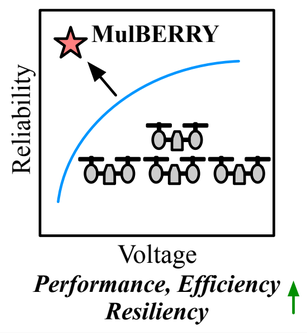


Power breakdown measured from 3DR Solo drone

✓ Challenge 3: low-voltage reduce energy quadratically but induce bit errors bringing reliability concern.

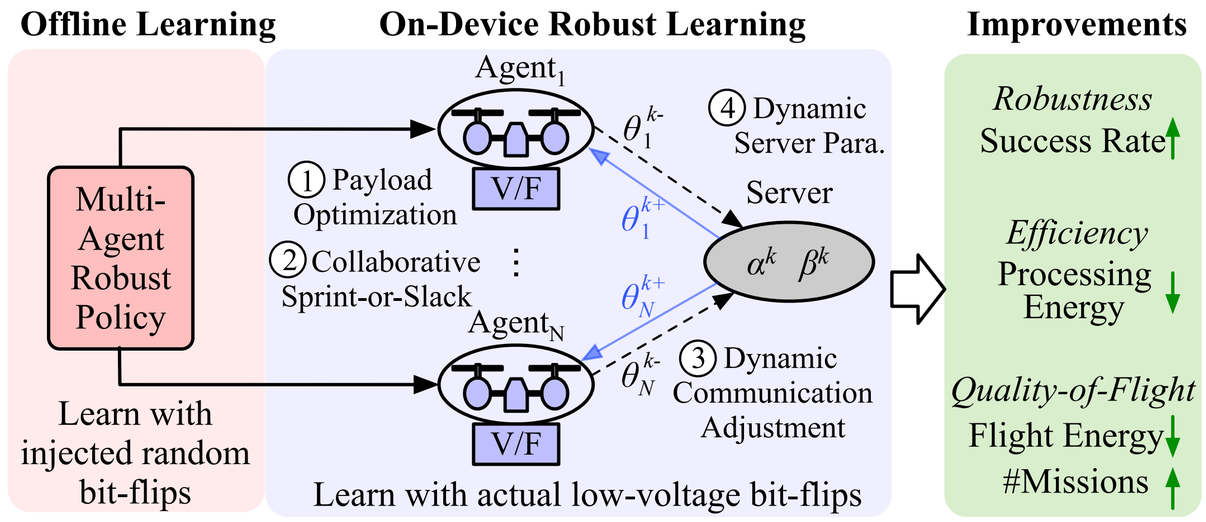


❖ **Goal:** Enable resilient and efficient autonomous swarms under low-voltage operation. (performance-efficiency-resilience co-optimization)



Proposed MulBERRY Framework

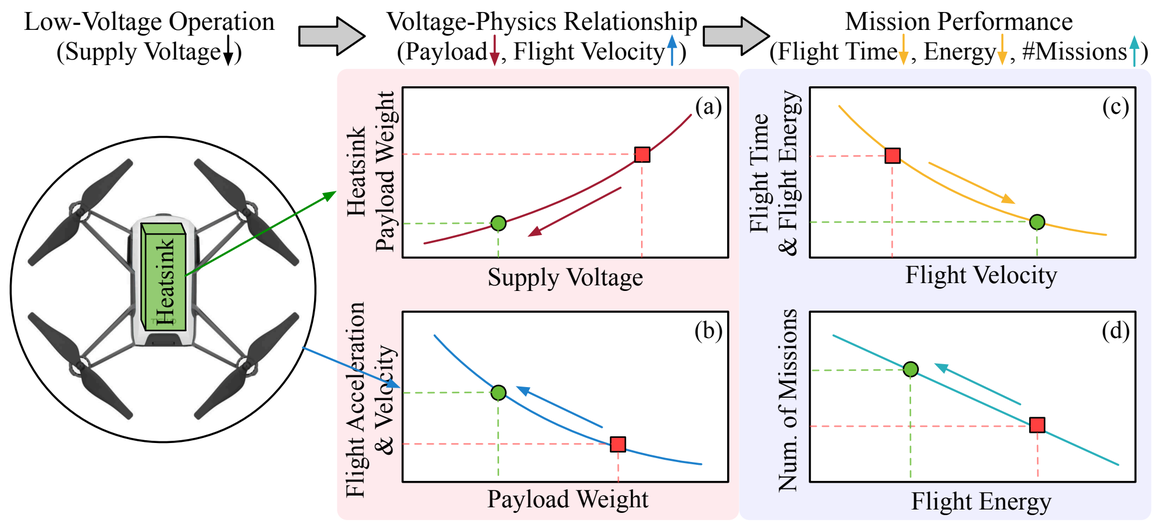
❖ **MulBERRY**: multi-agent robust learning framework to achieve aggressive energy-savings & compute-resilience



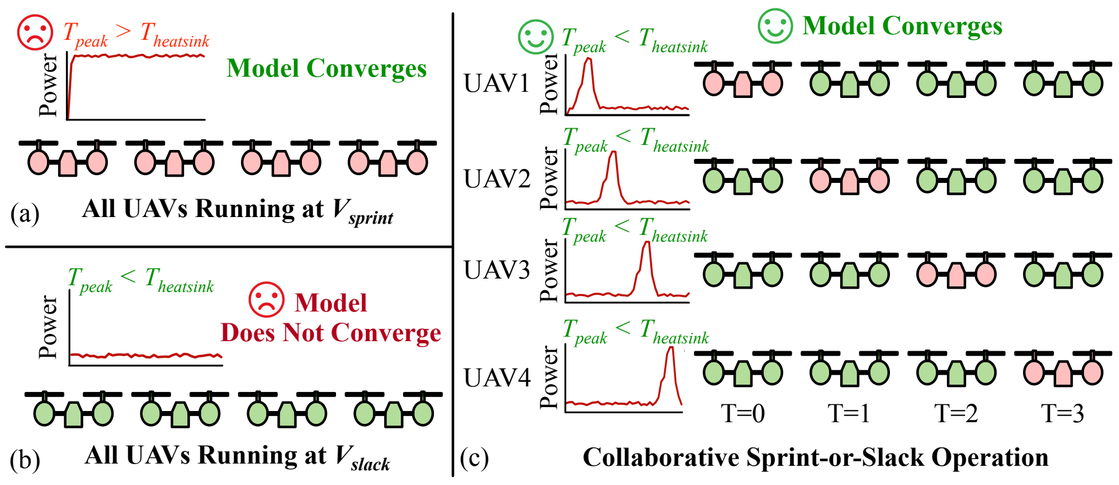
❖ **Key Features**:

✓ Two-stage offline and on-device robust swarm learning.

✓ Low-voltage UAV payload optimization.



✓ Collaborative sprint-or-slack operation.

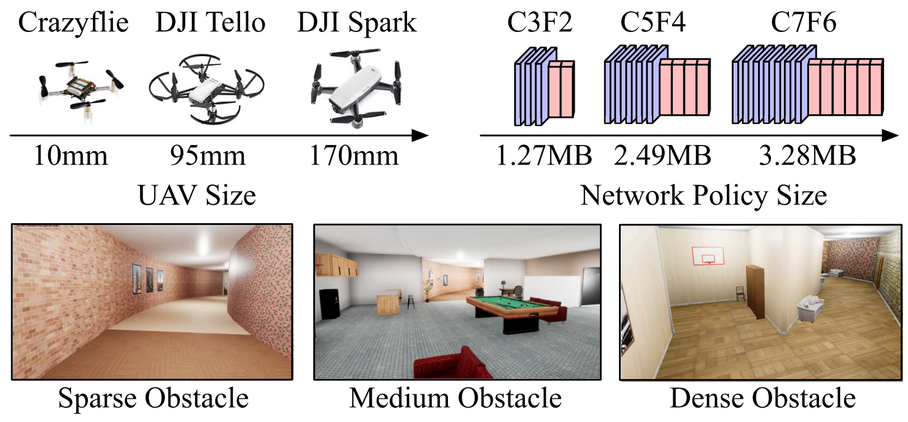


✓ Dynamic communication and parameter adjustment.

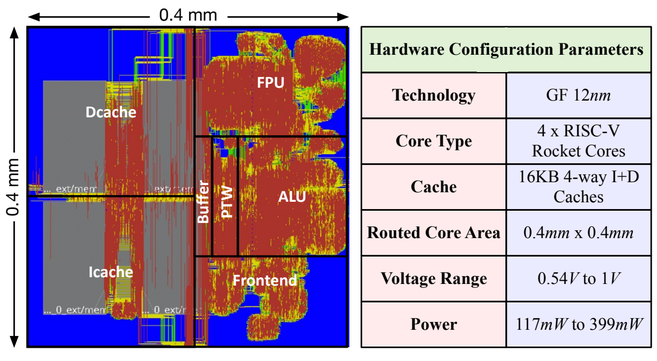
Evaluation Results: Towards Efficient and Resilient Autonomous Swarms

❖ **Evaluation Setups**

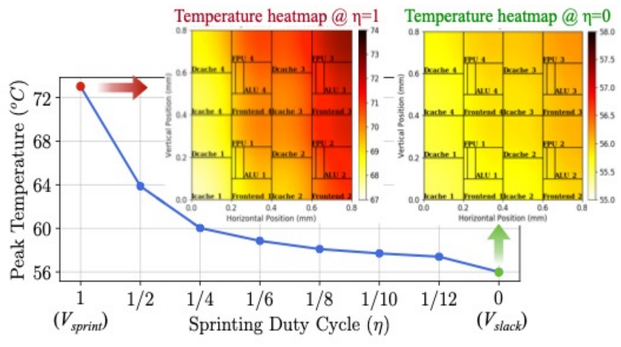
✓ Closed-loop eval.; Diverse environments, UAVs, models.

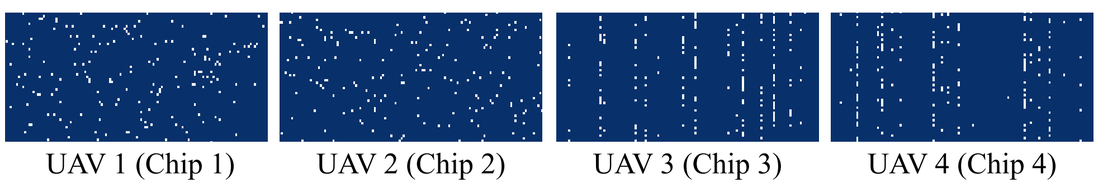


✓ UAV compute hardware and reliability characteristics.



Hardware Configuration Parameters	
Technology	GF 12*nm*
Core Type	4 x RISC-V Rocket Cores
Cache	16KB 4-way I+D Caches
Routed Core Area	0.4*mm* x 0.4*mm*
Voltage Range	0.54*V* to 1*V*
Power	117*mW* to 399*mW*

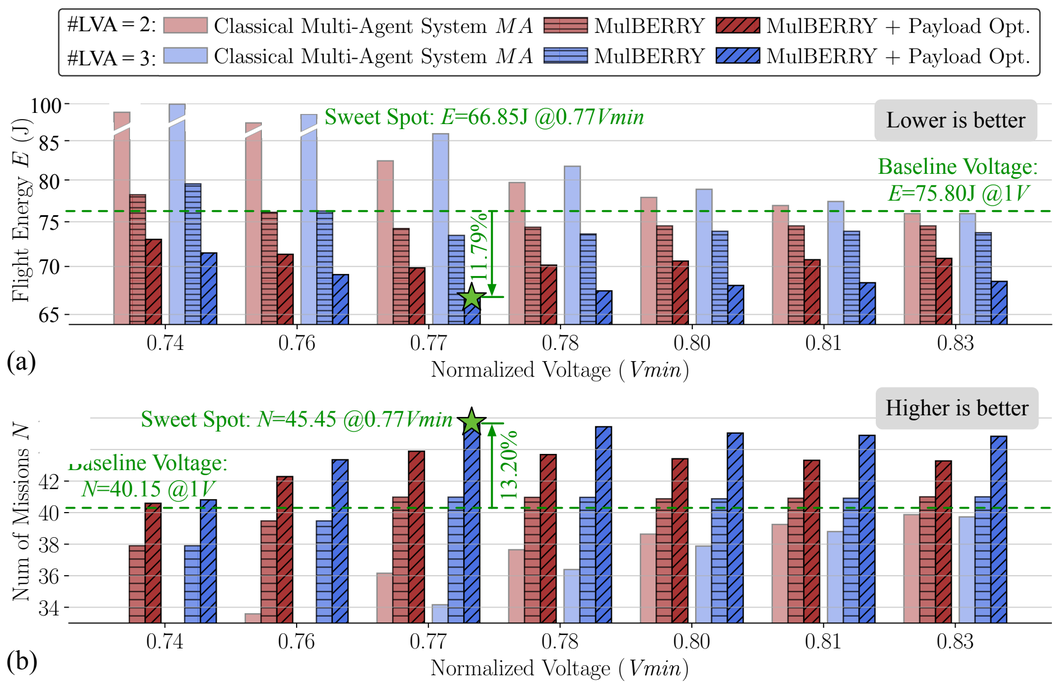




❖ **Resilience-Efficiency Improvement**

✓ Improve resilience, processing efficiency, and mission efficiency under robust low-voltage operation.

✓ Generalize across chips, voltages, environments, models, UAV types, and swarm sizes.



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