Collaborative Research: Design, Flight Control, and Autonomous Navigation of Bioinspired Morphing Micro Aerial Vehicles for Operation in Confined Spaces

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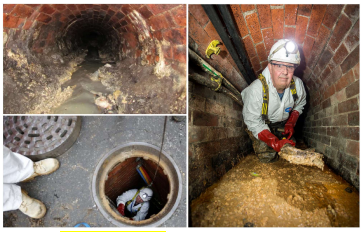
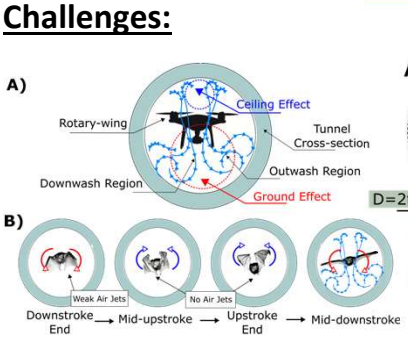
Motivation:

- ❖ Fast, efficient mobility in confined spaces
- ❖ UGV and UAS fail in confined spaces
- ❖ Tethered operation of slithering robots

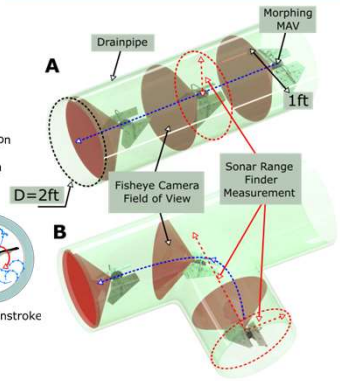


1.2 million miles of sewer networks in US

Challenges:



Dexterous manipulation of fluidic environment

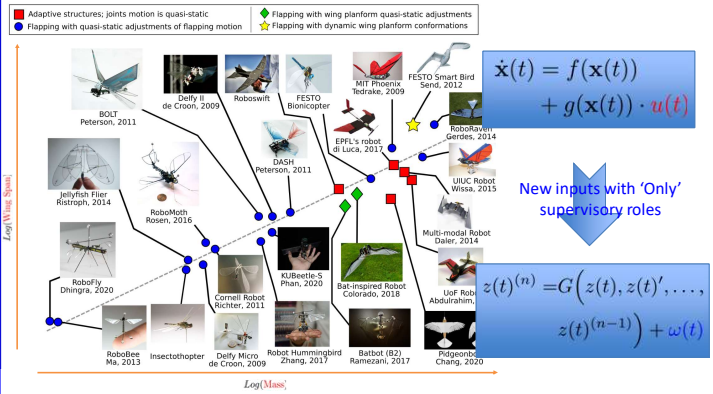


Task completion scenarios

Intellectual Merits:

Theory: Enhance morphology with static/dynamic state feedback and read-out to emulate any conceivable wake structure on some analogue input stream

Rationale: Morphology an affordable computational resource [Paul, 2006; Pfeifer and Bongard 2007; Hauser et al., 2012]

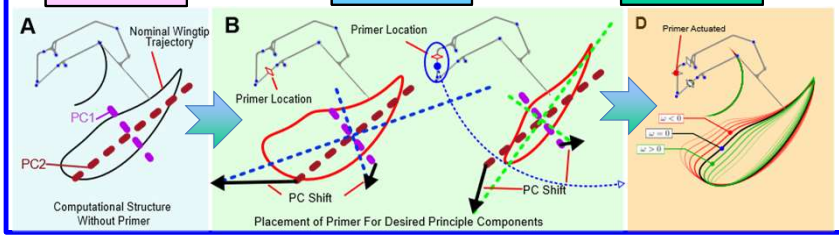


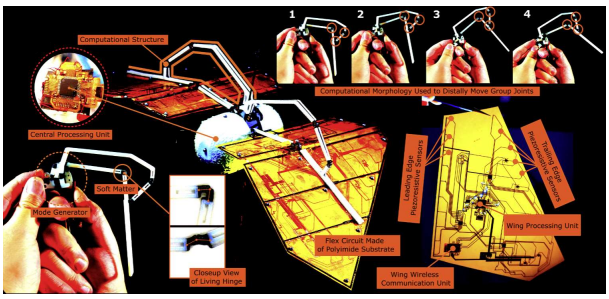
Approach:

Step 1: Structure Design

Step 2: Actuator Placement

Step 3: Structure Response Manipulation





Computational structure design

Broader Impact:

- Safety of Aerial Robotics
  - ❑ Infrastructure monitoring
  - ❑ Smart cities
- Robotic mechanisms
  - ❑ Medical robotics
  - ❑ Soft robots

- Integrated model-based, data-driven control framework
  - ❑ Aerial systems
  - ❑ Underwater vehicles
- ML-guided Navigation frameworks
  - ❑ Indoor GPS-denied spaces

Paper Bird Competitions:

- 6 graders and teachers
  - ❑ 100 < participants at Northeastern and Berkeley
  - ❑ Learning flapping flight principles

2023 FRR & NRI Principal Investigators' Meeting
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