

# Collaborative Research: NRI: FND: Flying Swarm for Safe Human Interaction in Unstructured Environments.

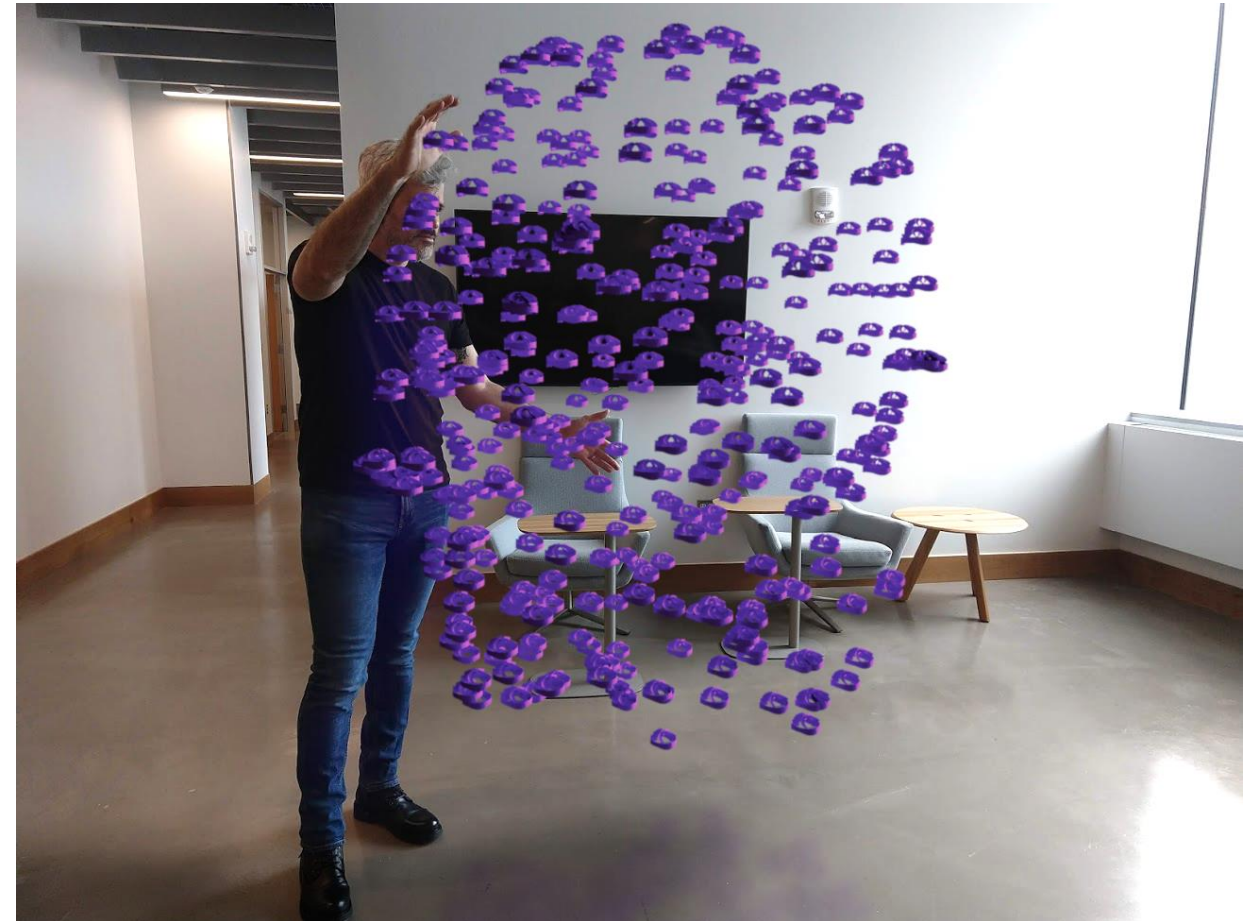
Michael Rubenstein (Northwestern), Mark Yim (UPenn)

Award # 2024615, start date 9/2020, Poster #108

**Objective:** We will design and create a swarm of 200 flying robots that are **safe** to operate around people in an **unstructured** environments. They will use only **on-board sensing** to interact with each other and humans, which can “sculpt” the shape of the conglomerate form.

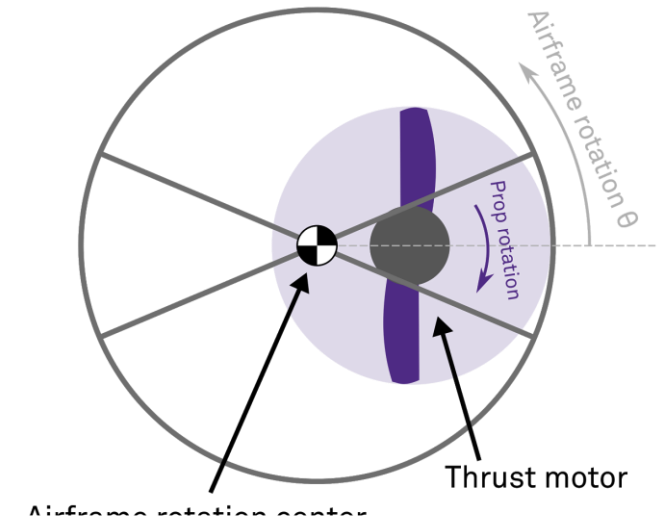
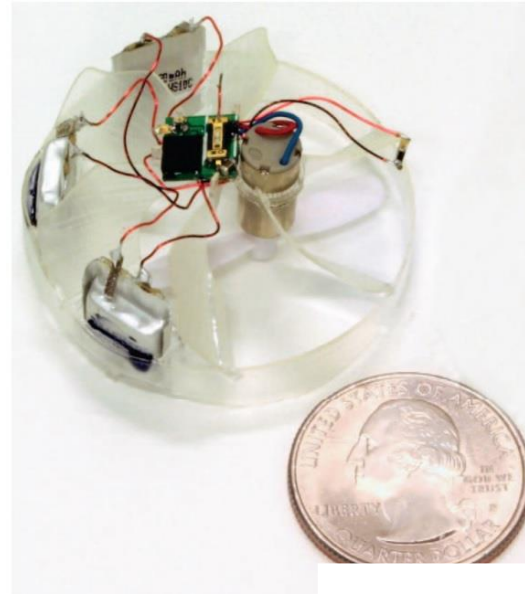
- Challenges

1. Inherently human safe robots.
2. Simple low-cost swarm capable flyers.
3. Use only onboard sensing and communication.



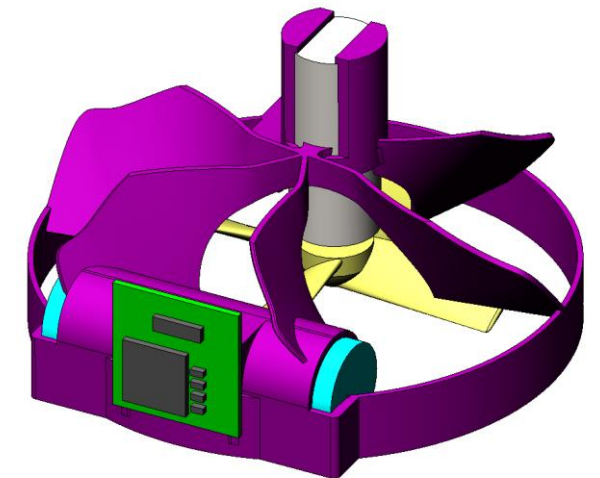
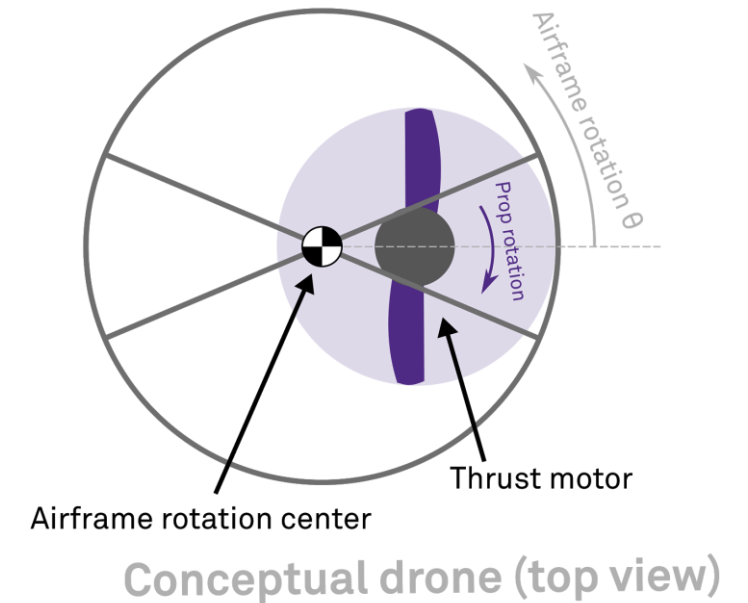
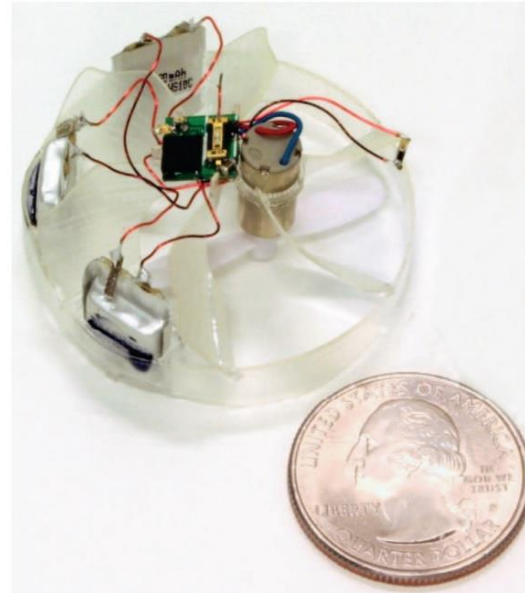
# MAV design

- Based on Piccolissimo drone
  - One of the smallest self-powered, controllable MAV
  - 1 DOF flyer
  - 2 moving parts
    - Chassis
    - Propeller



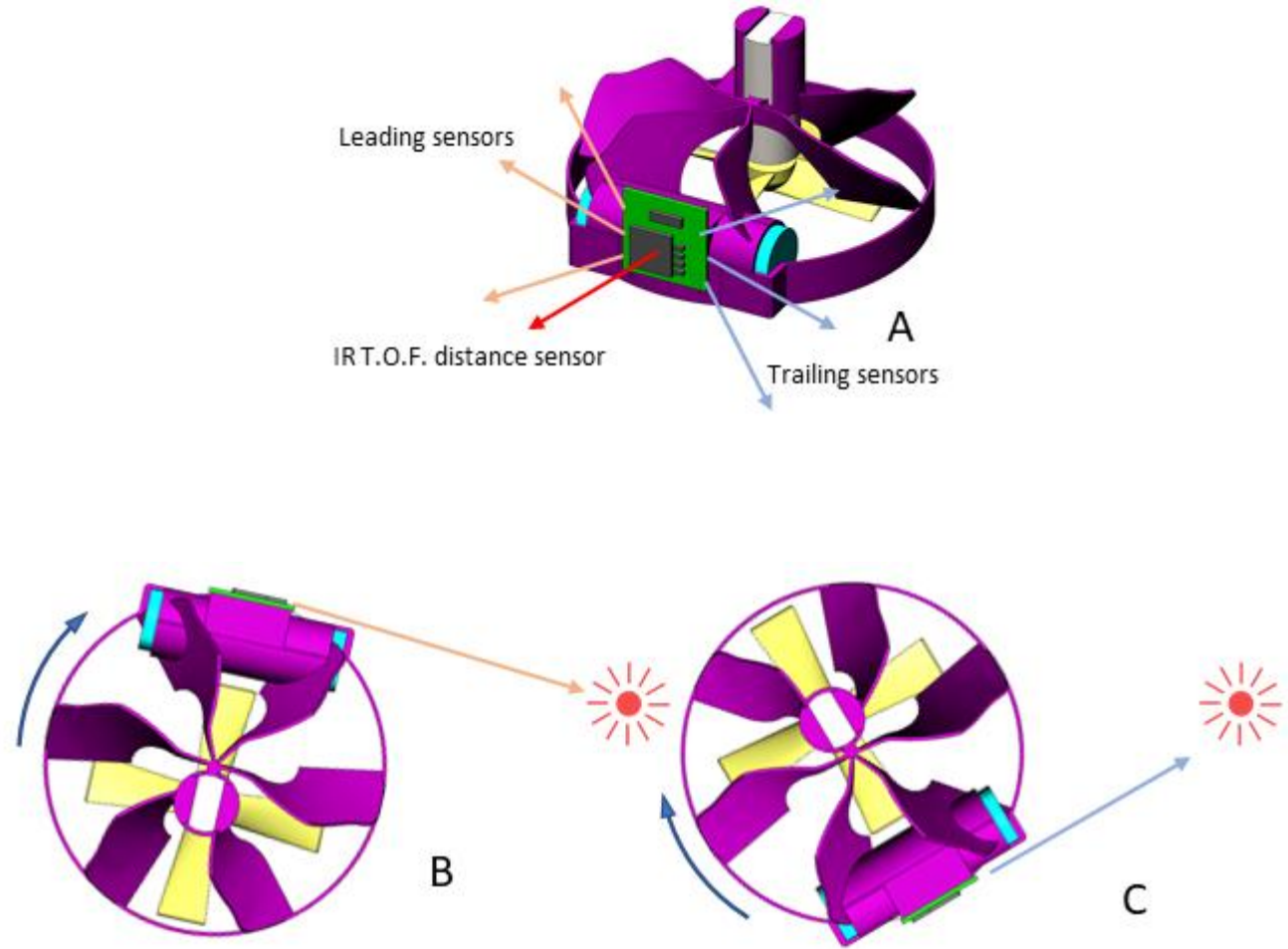
# MAV design

- Based on Piccolissimo drone
  - One of the smallest self-powered, controllable MAV
  - 1 DOF flyer
  - 2 moving parts
    - Chassis
    - Propeller
- ManP2
  - Approx. 20grams, 7cm diameter
  - Add sensing and onboard control
  - Swarm capable
    - Reprogramming
    - Charging
    - Operating
    - Low cost



# Sensing and Communication

- Outfit ManP2 with onboard sensing and communication
  - Outfit robots with IR transmitter
  - IR based receivers allow for sensing
    - Bearing
    - Elevation
    - Distance
  - Modulate light for data





# Collaborative Research: NRI: FND: Flying Swarm for Safe Human Interaction in Unstructured Environments.

Michael Rubenstein (Northwestern), Mark Yim (UPenn)

- Ongoing work:
  - Optimizing position control
  - Downwash
  - Launch and landing
  - Swarm algorithms

