# *Raining Drones:* Mid-Air Release & Recovery of Atmospheric Sensing Systems

Carrick Detweiler, Adam Houston (University of Nebraska-Lincoln)
Sebastian Elbaum (University of Virginia)

**Vision:** Develop techniques & foundations to aerially launch, and later aerially recover unmanned systems that profile Earth's lower atmosphere.

**Objectives:** Mid-air capture and release of several aerial systems, by,

- Planning & control for UASs docking and undocking mid-air;
- Matched maneuvers between heterogeneous classes of aerial robots;
- Strategies for rapid deploy-capture-redeploy cycles for teams of UASs;
- Run time inference of protocols and global plans to orchestrate interactions;
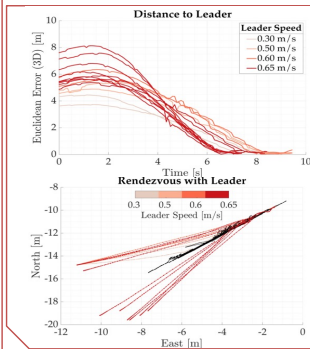- Estimating aerial-sensor responses and studying better profile patterns.
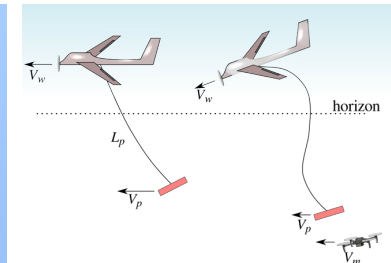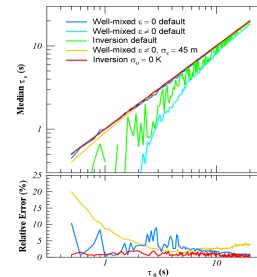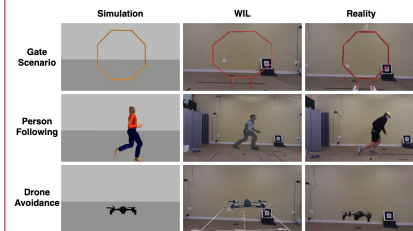


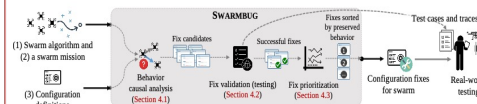## Activities, Contributions
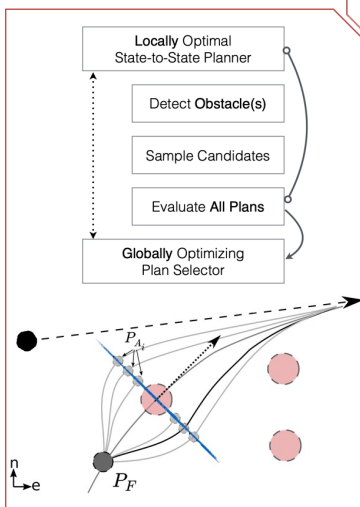


### UAS docking with obstacles

- Plan optimal docking trajectories
- Domain awareness: avoid downwash
- Precise localization, control outdoors
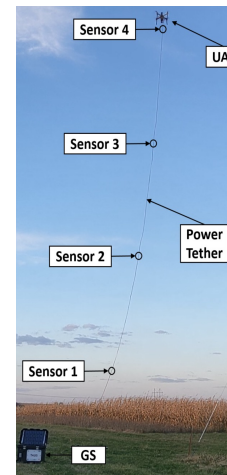- Avoids obstacles, dynamic replan



**World in the loop (WIL):** reducing simulation-reality gap with mix-reality



**Swarmbug:** debug and fix buggy swarm misconfigurations.



High-level flight stack for precise multirotor control:
https://github.com/unl-nimbus-lab/Freyja



### Broader Impact: Science, Society and Students

- Integrating teams of UASs into routine & periodic aerial profiling; directly impacting atmospheric science, and the ability to create accurate, descriptive and data-supported models of atmosphere.
- Generating unprecedented datasets that capture atmospheric thermodynamics over large geographical scales.
- The underlying techniques and systems will be applicable to other domains such as surveillance, hazard assessment, reconnaissance and other forms of multimodal exploration.
- Educational and outreach programs will help in expanding the audience for this work by disseminating curated knowledge to students & general public.