Data-Driven Adaptive Real-Time (DART) Flow-Field Estimation Using Deployable UAVs

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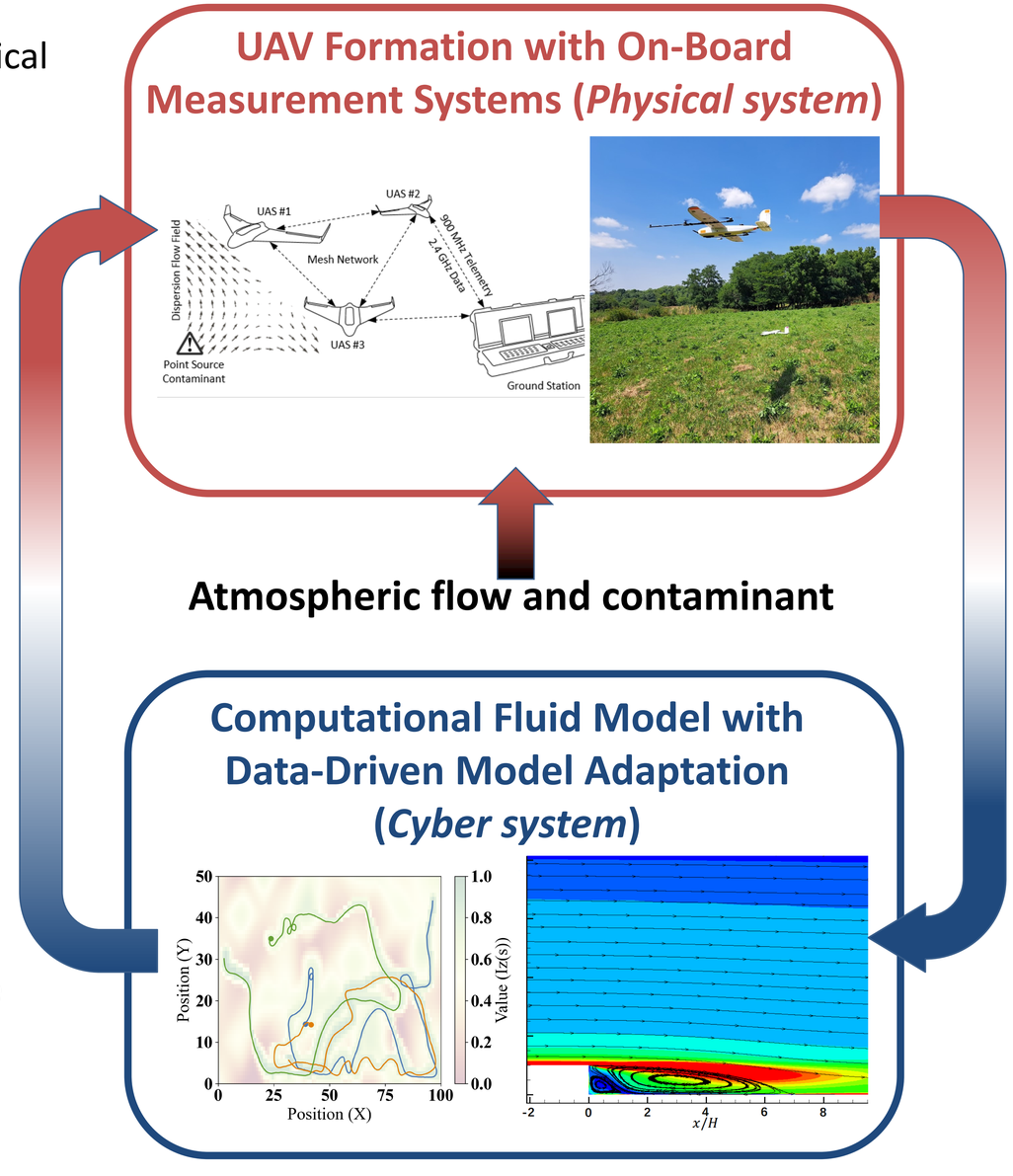
Challenge:

- To produce accurate micrometeorological estimates and to **forecast airborne contaminant dispersion in real-time**
- Accurate prediction is challenging because of **atmospheric turbulence, ground terrain topology, changing wind conditions**

Solution:

- DART CPS consists of a computational fluid dynamic **(CFD) cyber system** and a physical system of **autonomous instrumented UAVs**
- UAVs obtain **sparse physical measurements** of the atmospheric flow and contaminant concentrations
- DART algorithm uses sparse physical measurements to **continually improve predictive capability of a CFD model**



Scientific Impact:

- Project aims to advance several areas that could apply to other CPS:
  - –Real-time **data-driven model adaption**
  - –Advances in CFD **turbulence modeling**
  - –Improvements in **UAV-based sensing** and data processing
  - –**Cyber-feedback formation control** for autonomous vehicles

Broader Impact:

- Accurate real-time prediction of airborne contaminant dispersion is **critical for planning emergency response**
  - – Fukushima Daiichi disaster and Aliso Canyon natural gas leak
  - – Other examples: forest fires, oil spills, fracking accidents, train derailments
- Project impacts education (**10 undergrad and 6 grad students**) and outreach on use of UAVs for a variety of applications (e.g., first responders)
- **Data-driven model adaptation** can be in other CPS and non-CPS areas (e.g., ID of model parameters from data in less time)