Drone Intention Prediction using Complementary Learning of Data Driven Techniques with Flight Physics

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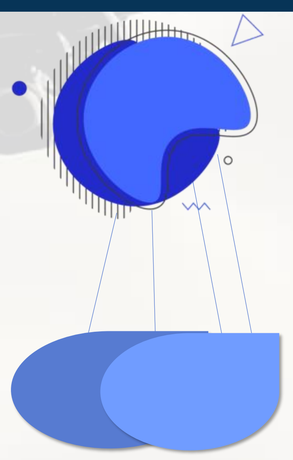
Background

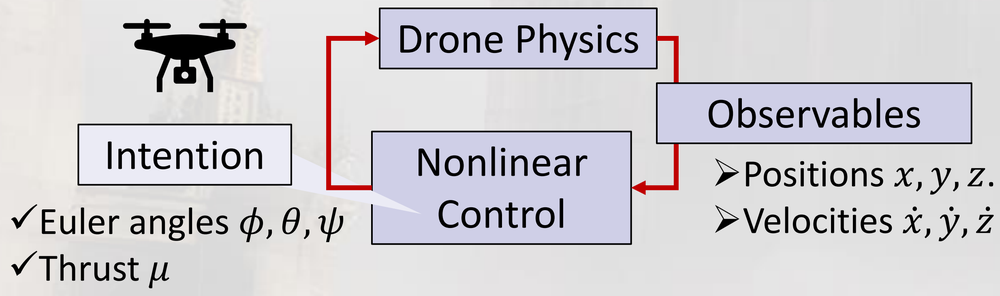
- Increased proliferation of drones and autonomous systems can **disrupt** critical national services (e.g., airports).
- The challenge with current detection systems is **false positives**.
- The rapidly changing design, flexible capabilities, and diverse underpinning algorithms of drones makes distinguishing malicious from naïve intentions difficult.
- Inference of **drone intention** using observational data alone is unreliable.

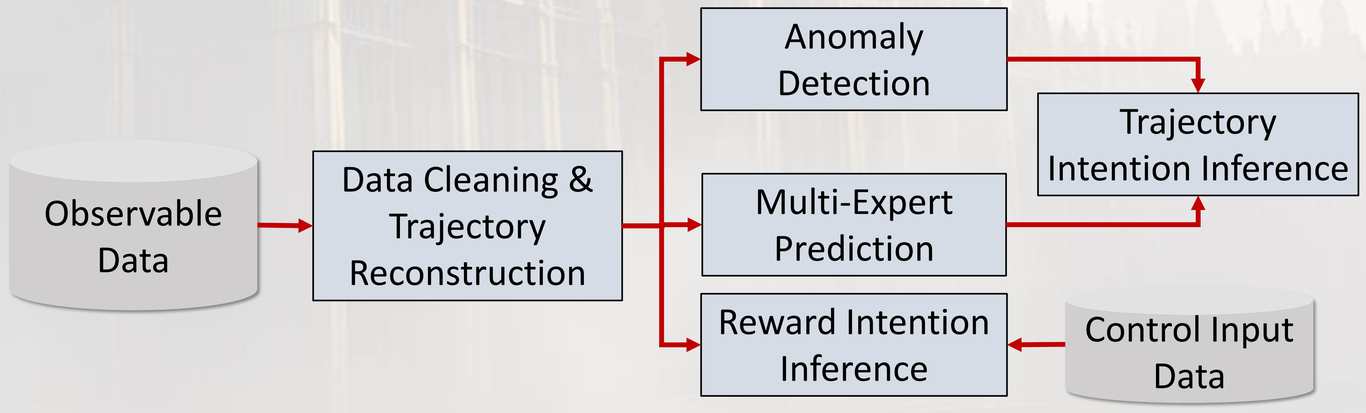
Intention high-dimensional intangible construct

Intention classes: low-dimensional proxy

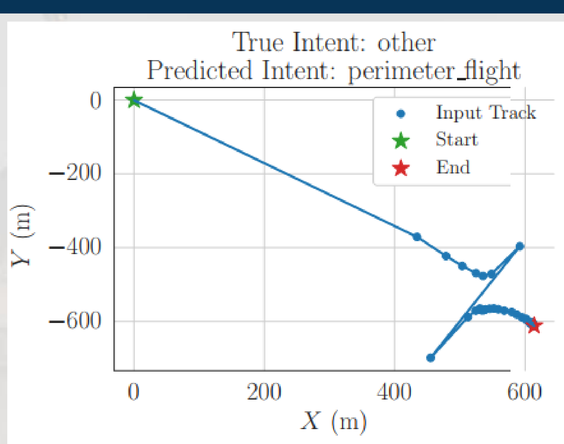


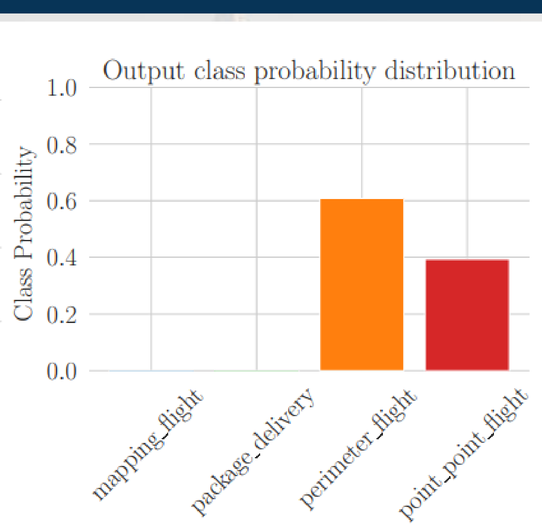
Methodology[1]

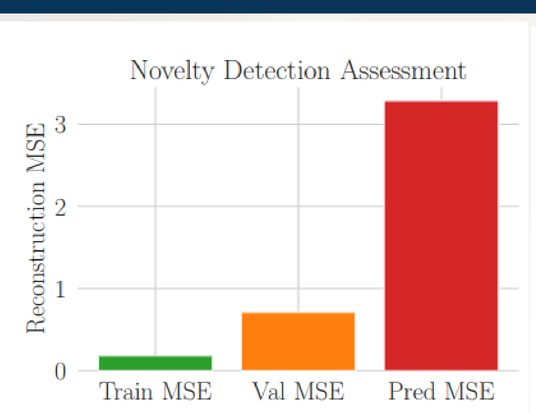


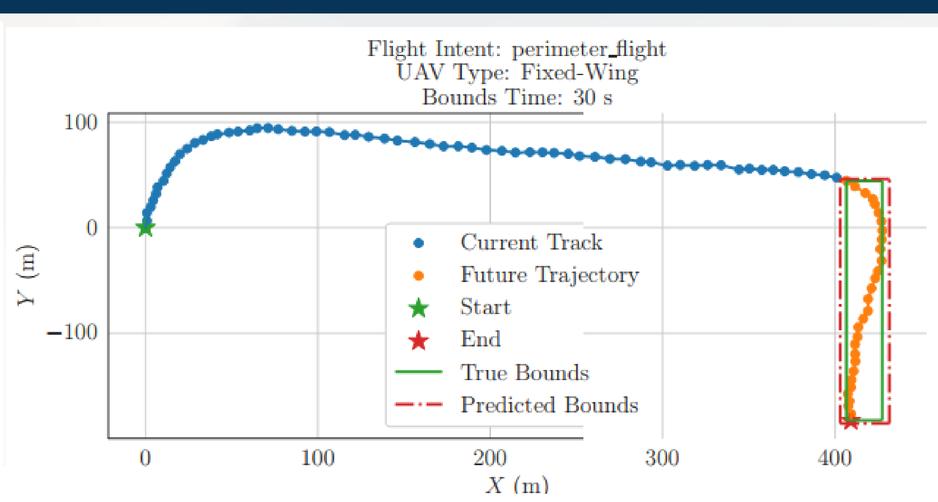


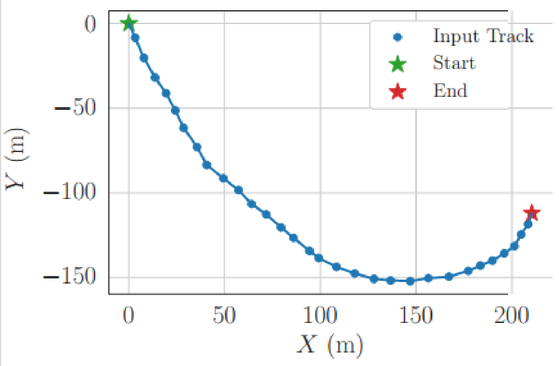
Preliminary Results

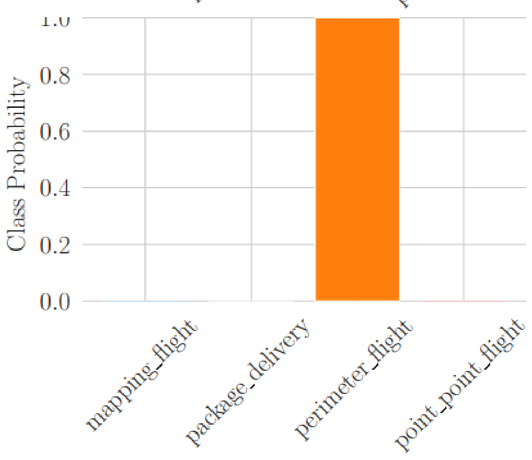


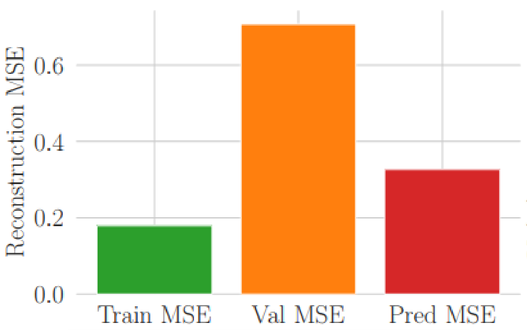




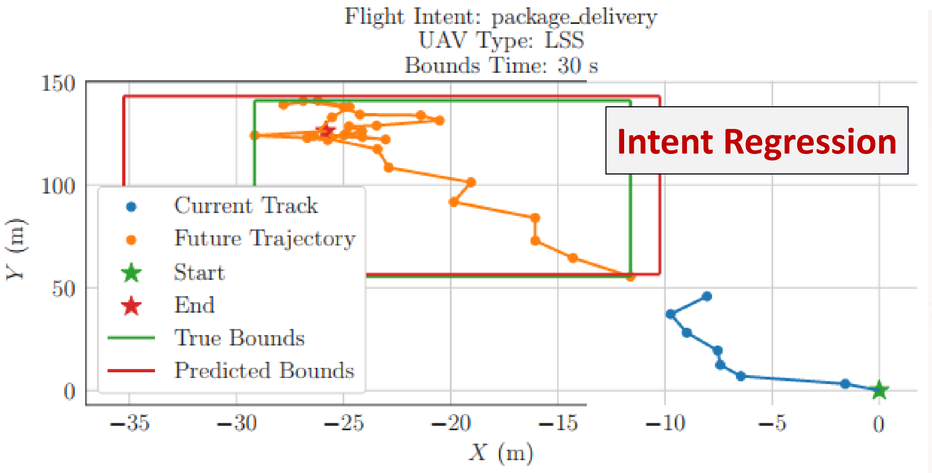




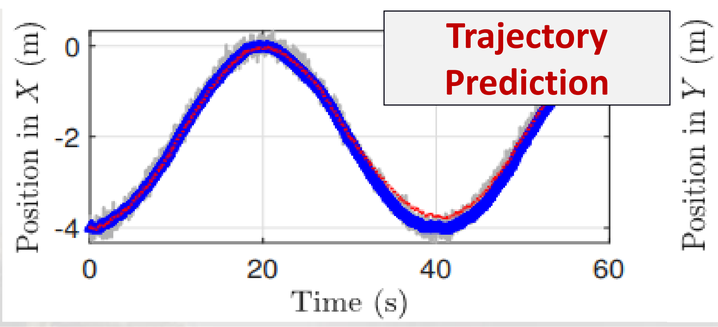




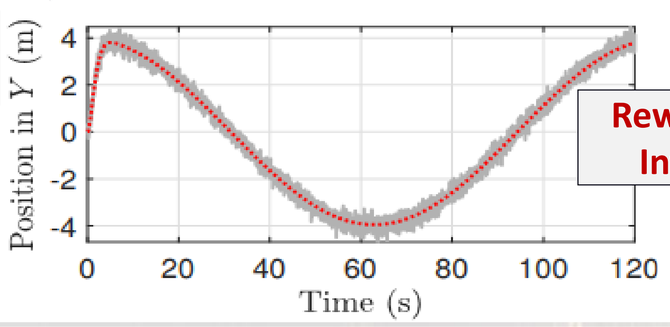
Intent Classification & Novelty Detection



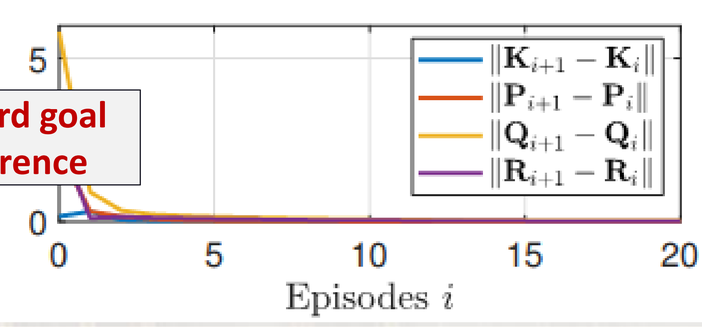
Intent Regression



Trajectory Prediction



Reward goal Inference



Conclusions

- Intention ranges from trajectory to reward goals.
- Trajectory intention includes the purpose of use and the intended destination.
- Reward intention provides the most succinct and robust definition of the task that the drone aims to perform.
- The incorporation of physics-informed model regularizes the learning manifold of data-driven models.

1. *Uncovering Drone Intention using Control Physics Informed Machine Learning*, PREPRINT: Research Square (Nature Communications Engineering), 2024.

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