AI Safety and Certification in Learning-based Aviation Systems

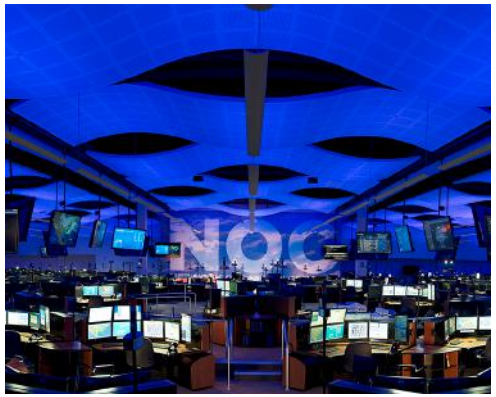
Peng WEI
Associate Professor
Mechanical and Aerospace Engineering
Electrical and Computer Engineering (by courtesy)
Computer Science (by courtesy)
George Washington University
Email: pwei@gwu.edu
Tel: 202-994-0895
https://web.seas.gwu.edu/pwei/

Intelligent Aerospace Systems Lab (IASL)

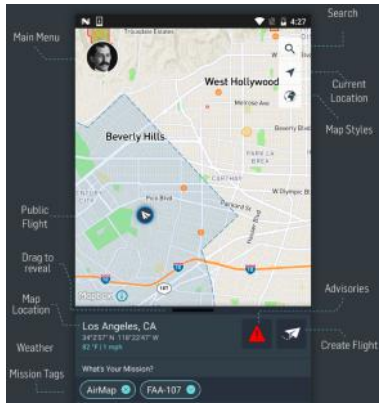
We develop models, algorithms and automations for aviation, transportation and robotics

- **Methods:** control, optimization, machine learning, artificial intelligence
- **Applications:**

Air Traffic Control/Management



Airline Operations



UAS Traffic Management

Electric Vehicle Prognostics

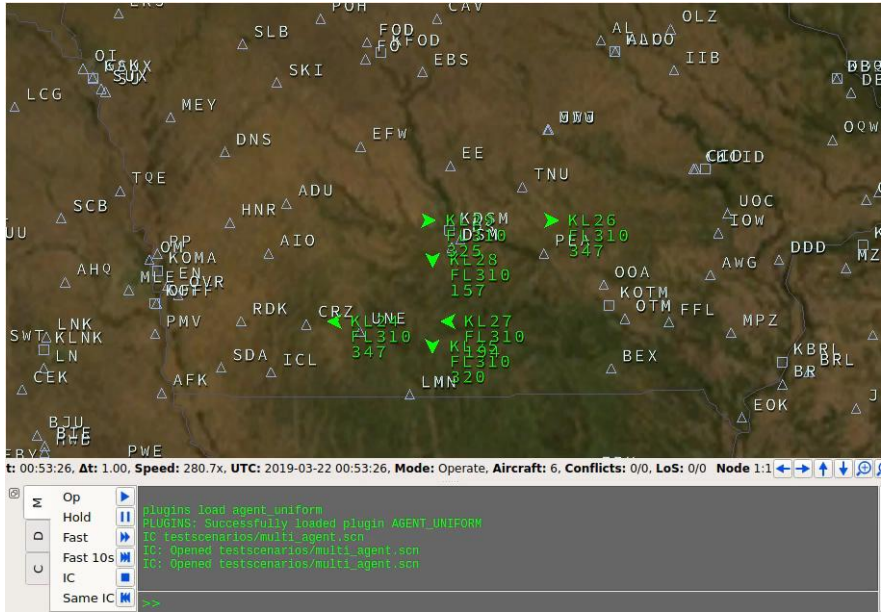
eVTOL Urban Air Mobility

Autonomous Drone Racing

ML/AI based Aviation Systems

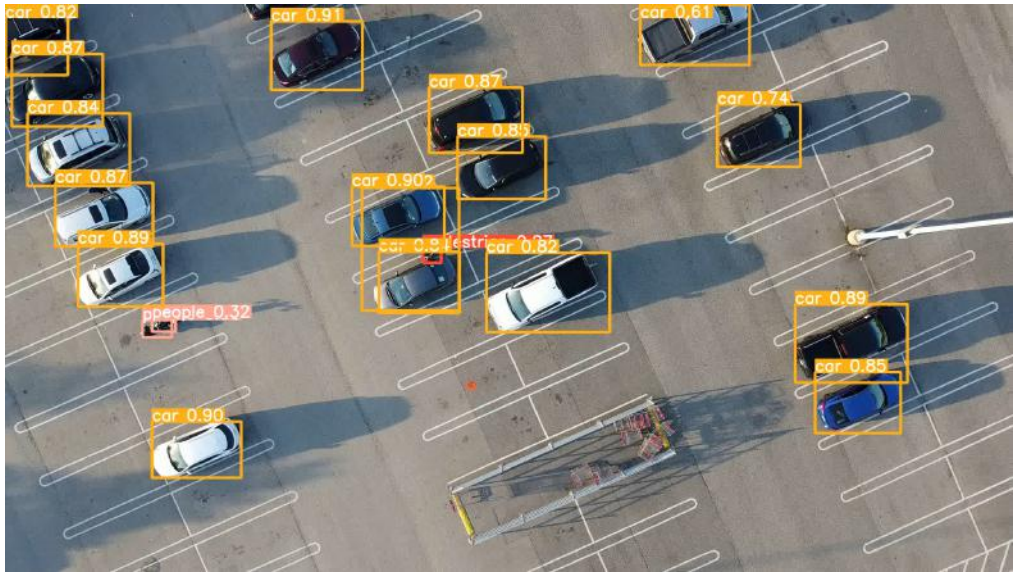
Aircraft Separation Assurance

- Multi-agent reinforcement learning
- Neural net based controllers
- Safety critical



Vision-based AutoLanding

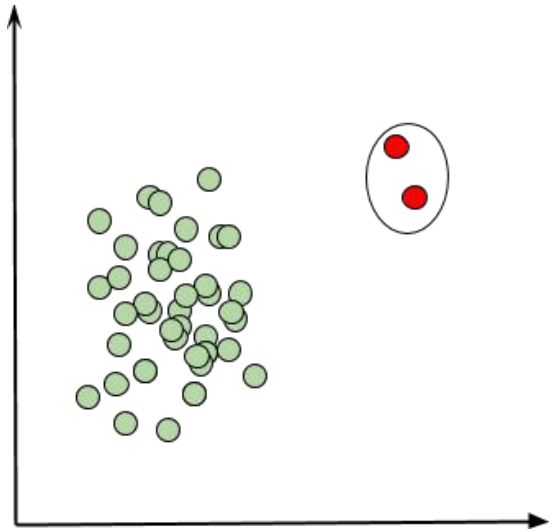
- ResNet or YOLO (CNN)
- Neural net based perception and prediction
- Safety critical



How to certify ML/AI Systems in Aviation?

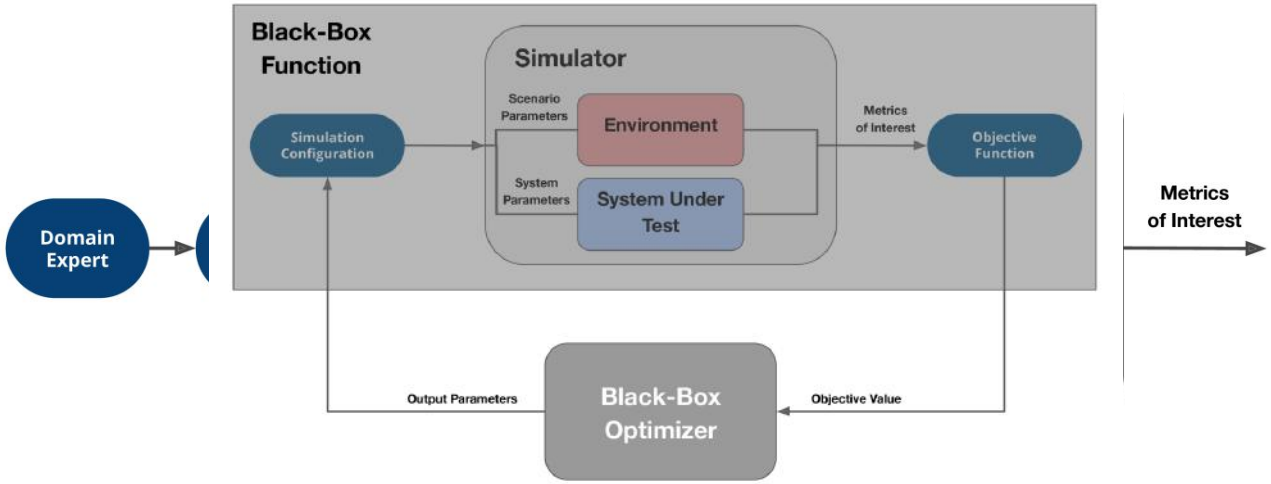
Our Scope of AI Systems

- Data-driven Learning-based Systems
  - How well can a data-driven learning-based system generalize in new scenarios or new datasets? such as in computer vision, NLP, reinforcement learning, etc.
  - How do we generalize better with physics and/or causal knowledge?
  - How can we tell it won't work in execution time?



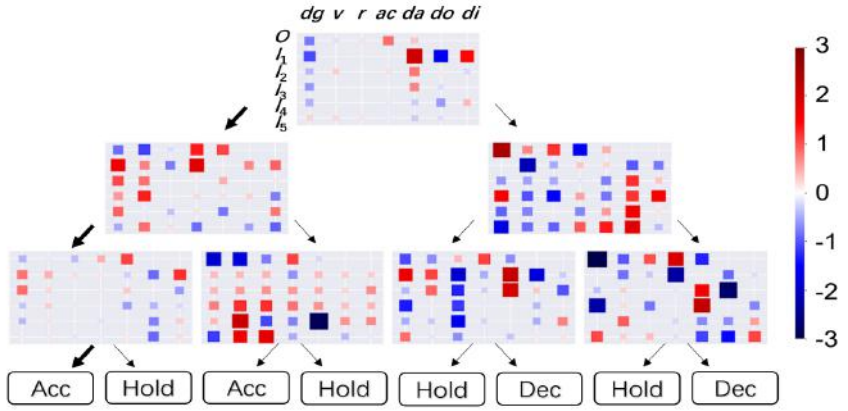
Our Scope of AI Systems

- Neural Networks in the Loop
  - Study the mathematical/statistical foundation of the neural net and its formal analysis/verification, instead of treating it as a blackbox
  - Formal verification
  - Online safety guard
  - Using AI to verify AI (adaptive stress testing)



Our Scope of Trustworthiness

- What is trust in safety-critical systems?
  - Safety guarantee/verification (satisfying hard constraints, offline verification and online monitoring)
  - Can be certified, audited, and/or regulated (meeting the requirements via testing evidence or verification proofs)
  - Can be explained/interpreted (human-machine teaming)



Collaboration Channels

- Joint publications?
- Co-advise PhD students?
- Student exchanges?
- Research projects?

Obrigado. Muito feliz por estar aqui.

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