Aerospace Engineering Partage d'Expérience

Alex Zongo

Doctorant en Ingenierie Mechanique

et Aerospatial

Intelligent Aerospace Systems Lab

George Washington University

Take-Aways

- ✓ From a dream to realization: (Believe in your dreams) **Croyez en vos reves**
- ✓ Start small - **Commencez petit**
- ✓ Push boundaries - **Repoussez les limites**
- ✓ Contribute & Collaborate - **Contribuez et collaborez**
- ✓ Pass down knowledge - **Transmettez vos connaissance**

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1. Self-Introduction and Journey - **Presentation personnelle et parcours**
2. Ice-Breaker. (definition de l'Ingenierie Aerospatial)
3. Projects and Research - **Projets et focus de recherches**
4. Suggestions domain specialization - **Suggestions pour la specialization dans le domaine**
5. Q & A

My Journey

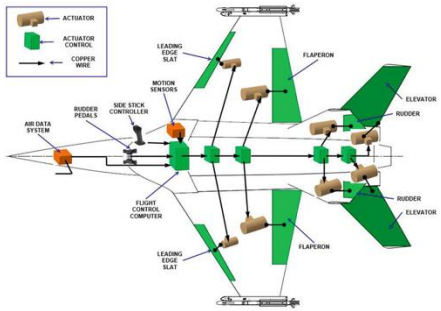
- 2024-today: **PhD in Mechanical and Aerospace Engineering** at GWU, USA
- 2021-2024: **Msc. in Control Science and Engineering** from Tsinghua University, China,
- 2022: **Machine Learning Summer School** at the University of Oxford, UK,
- 2018-2021: **Bsc. in Flight Vehicle Design and Engineering** from Beijing University of Aeronautics and Astronautics (Beihang University), China.
- 2017-2018: **Freshmen in Aeronautical and Astronautical Engineering** at National Cheng Kung University, Tainan, Taiwan
- 2016-2017: **Traditional Chinese (Mandarin)** at Fu-Jen Catholic University, Taiwan
- 2015-2016: **Math-Physics-Computer Sciences** at Université Nazi-Boni, Burkina Faso,
- 2008-2015: **Middle and High-School** at Notre Dame de l'Espérance, Burkina Faso,
- 2000 – 2008: **Primary School**, Sainte Therese de l'Enfant Jésus, Burkina Faso,
- 1997-2000: **Best Life** (la belle vie 😁)

- Alex Baowend Soom Marie Anicet Zongo
- https://github.com/Alex-Zongo
- https://alex-zongo.github.io
- https://www.linkedin.com/in/alex-zongo/

Ice-Breaker

What is Aerospace Engineering?

C’est Quoi le Genie Aérospatial

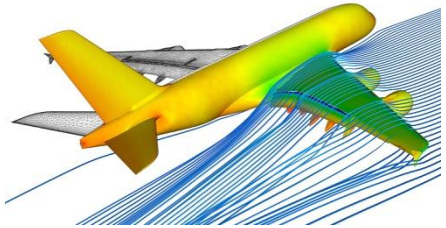


https://www.intechopen.com/chapters/82261

Control Engineering

Contrôle

https://medium.com/@theter/aerodynamics-flight-mechanics-0-296e6fce4ad4



Aerodynamics

Aerodynamique

https://www.nature.com/collections/ecjehiebic

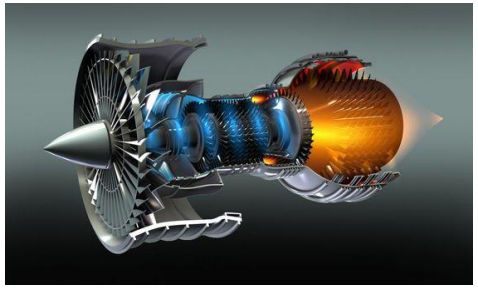
Material Sciences

Science des Materiaux

https://www.universalavionics.com/

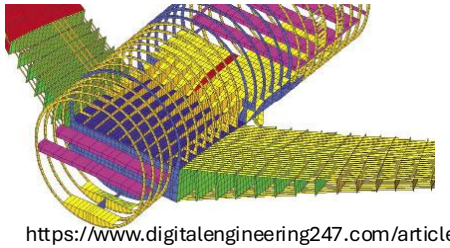
Avionics

Avionique



Propulsion

https://fullafterburner.weebly.com/next-gen-weapons/a-brief-description-of-propulsion-introduction

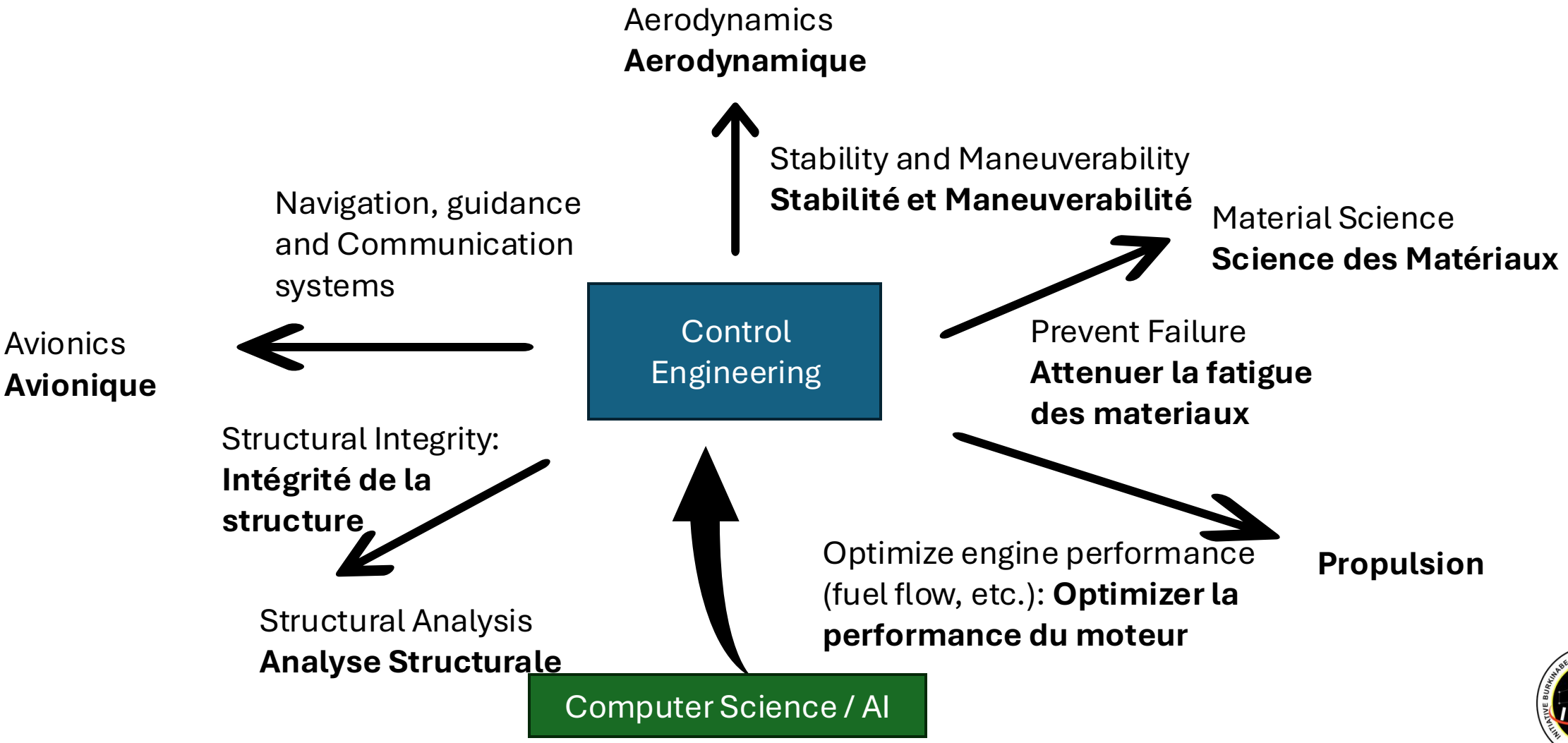


Structural Analysis

Analyse Structurale

https://www.digitalengineering247.com/article/flying-structural-fea

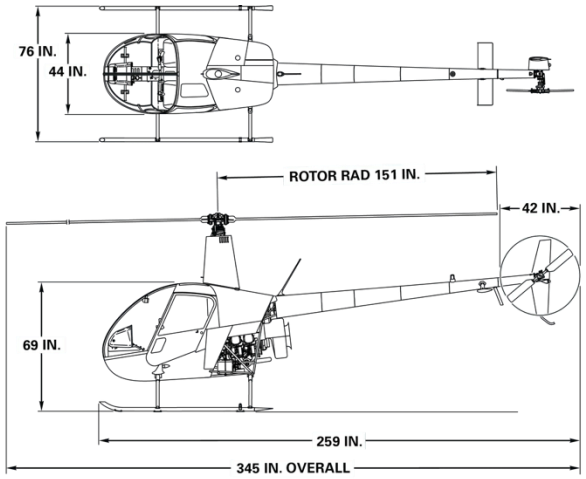
Control Science / Engineering



Projects and Research

Undergrads -

- Preliminary Design of a Lightweight Transport Helicopter –
- **Conception préliminaire d'un hélicoptère de transport léger**



- Moteur Lycoming O-320
- Charge utile : 150 kg
- Poids brut maximal : 600 kg
- Plafond de vol : > 1 km
- Vitesse maximale de vol : 206 km/h
- Taux de montée maximal : ≥ 6 m/s
- Autonomie maximale : ≥ 500 km
- Reference: Robinson 22 B

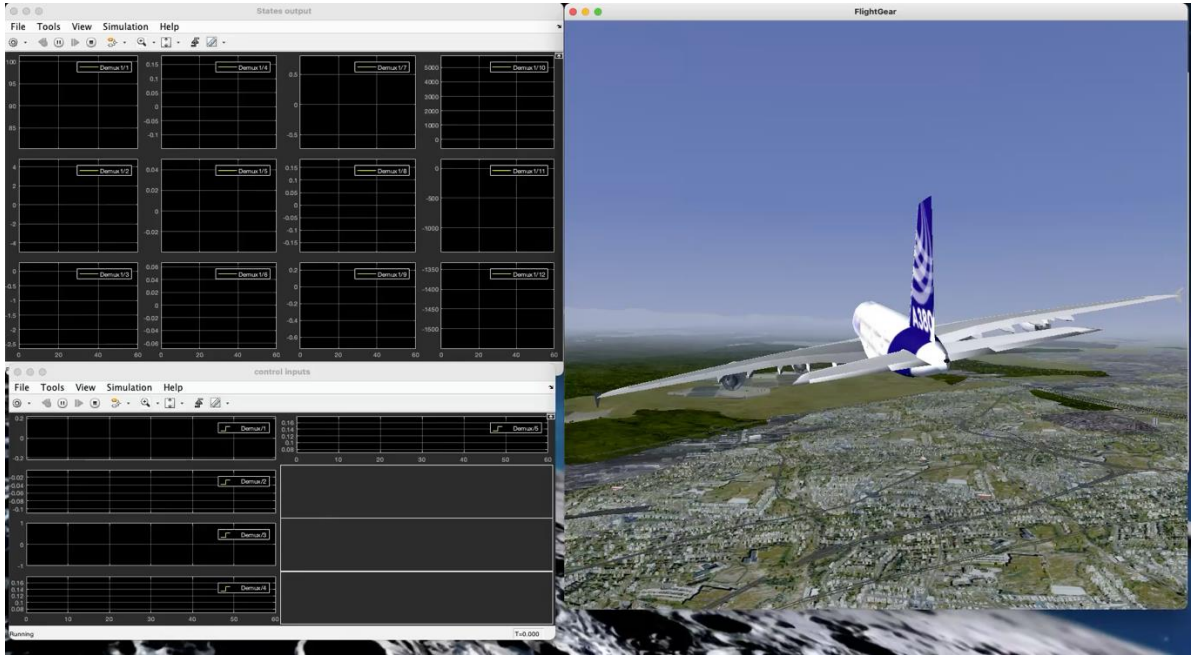
Preliminary Design of Lightweight Transport Helicopter

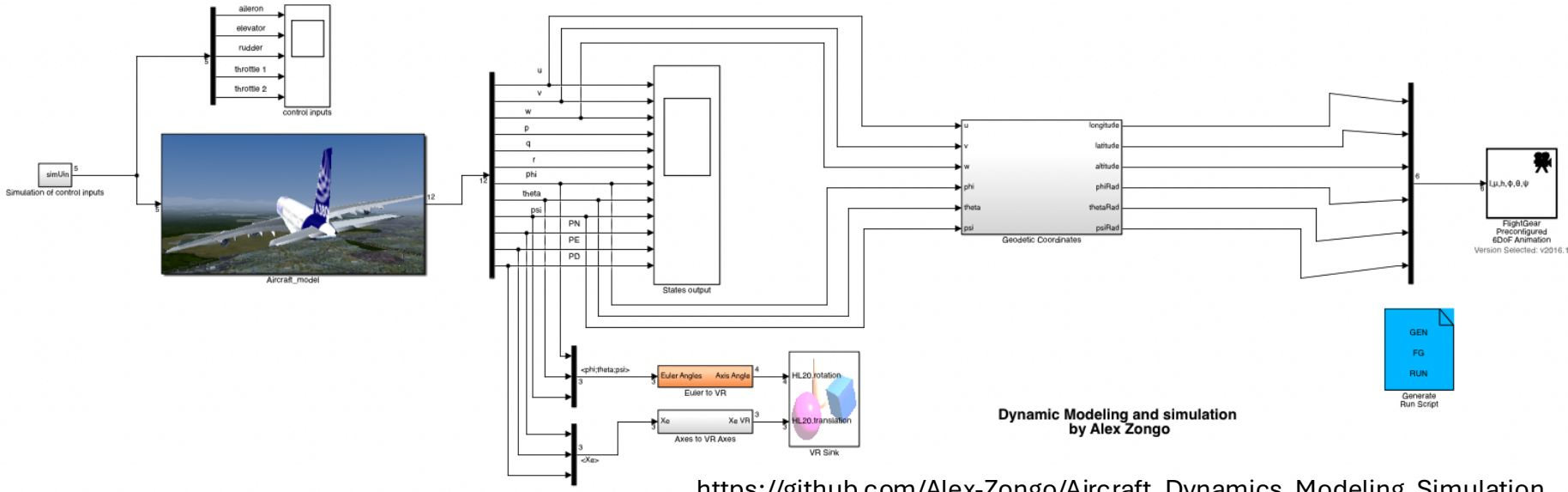
https://www.robinsonheli.com/helicopters/r22-beta-ii

Projects and Research

Undergrads -

- Aircraft Dynamic Modeling and Simulation –
- **Modélisation dynamique et simulation d'aéronefs**





https://github.com/Alex-Zongo/Aircraft_Dynamics_Modeling_Simulation

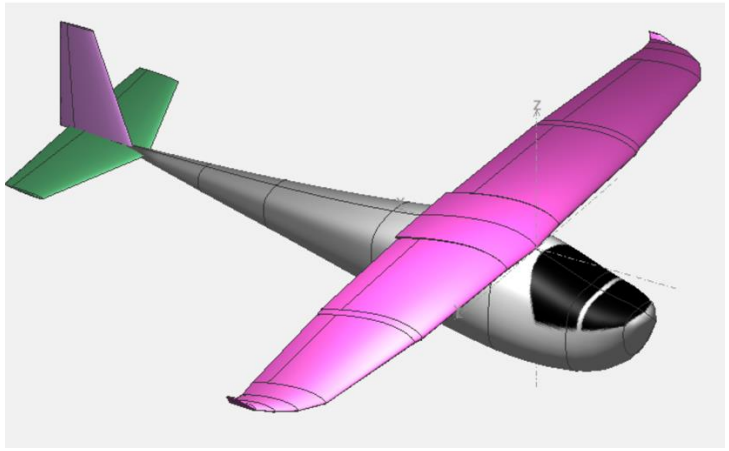
Projects and Research

Undergrads -

Thesis:

- Two-Seats Lightweight Airplane Conceptual Design

(**Conception Préliminaire d'un avion leger à deux place**)



- Poids maximal au décollage
- Vitesse de décrochage
- Vitesse de croisière
- Vitesse maximale
- Plafond de service

Performance
Range, Endurance, stability, etc.

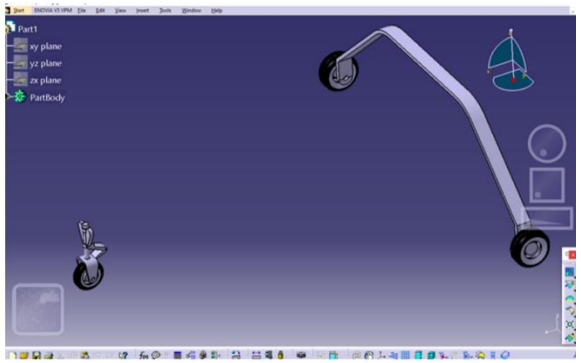
Design Conceptuel

Geométrie

Aerodynamics

propulsion

Weight & Balance



Projects and Research

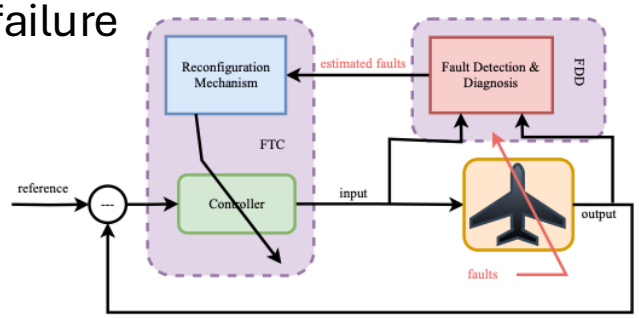
Grads -

- Research Assistant in the Navigation and Control lab, Tsinghua University (**Assistant de recherche au laboratoire de navigation et de contrôle**)

- Zongo, A.B., Qing, L. (2025). "*Towards Intelligent Fault-Tolerant Attitude Flight Control of Fixed-Wing Aircraft*." https://doi.org/10.1007/978-981-96-2264-1_15.
- ***Vers un contrôle de l'attitude vol, intelligent et tolérant aux pannes des aéronefs à voilure fixe***

Motivation

- Safety
- Diverse range of failure that can happen
- adaptability



Approach

- Model-based to Model-free Learn-based policy
- Learn-based model identification
- Stability and Control Safety Analysis

Projects and Research

- Research Assistant in the Navigation and Control lab, Tsinghua University

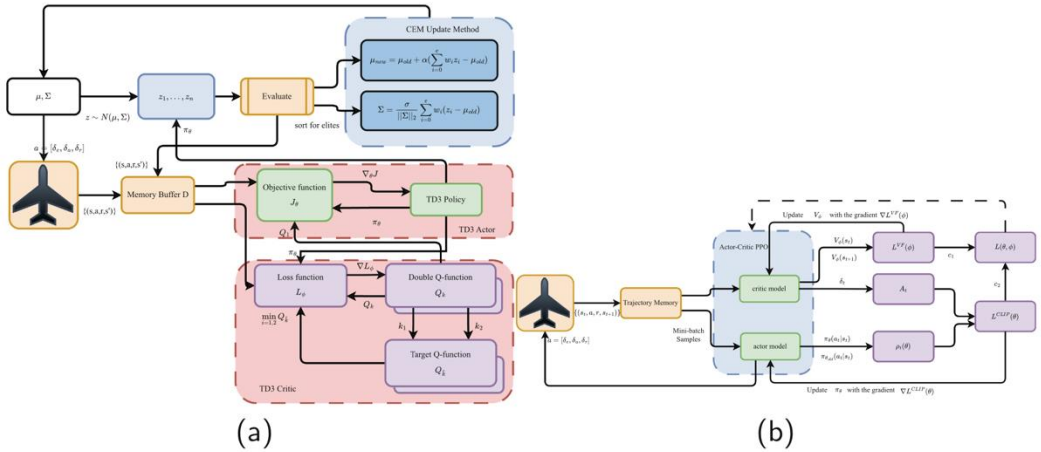
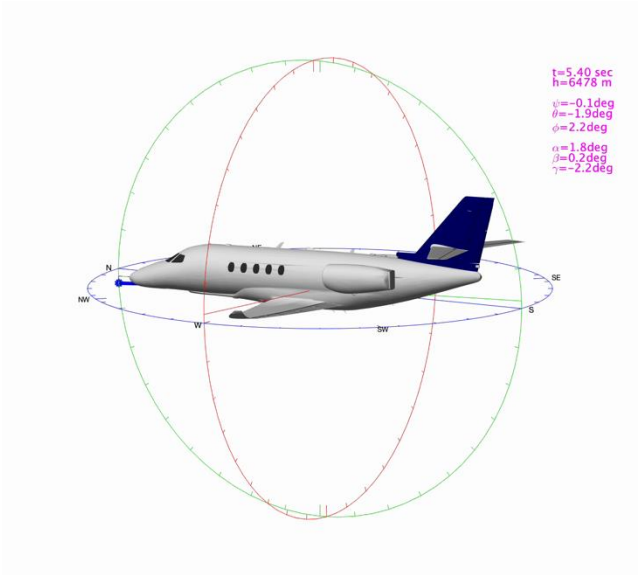


Fig. 1. CEM-TD3 Architecture **(a)**. PPO Learning Architecture **(b)**.



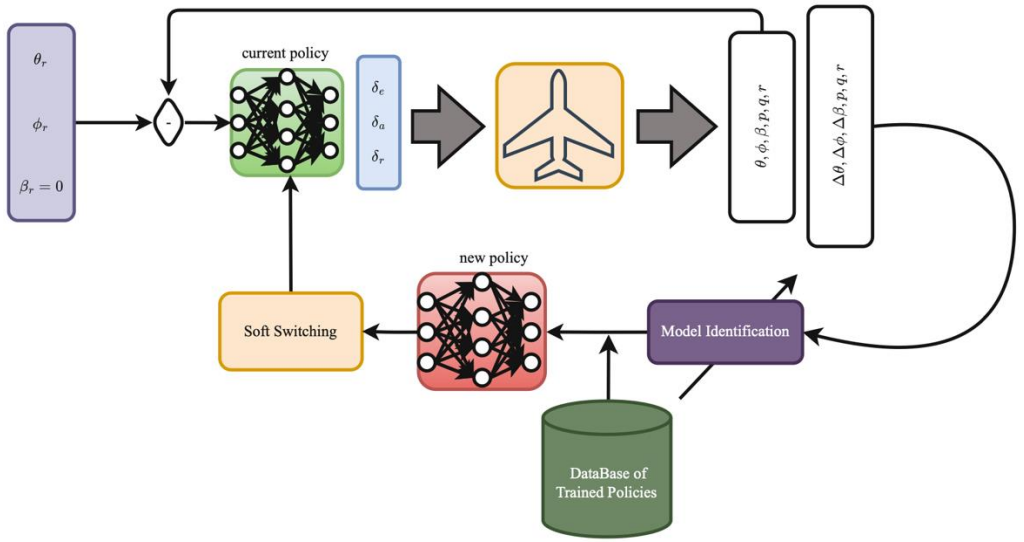


Fig. 2. High-Level Adaptation Mechanism

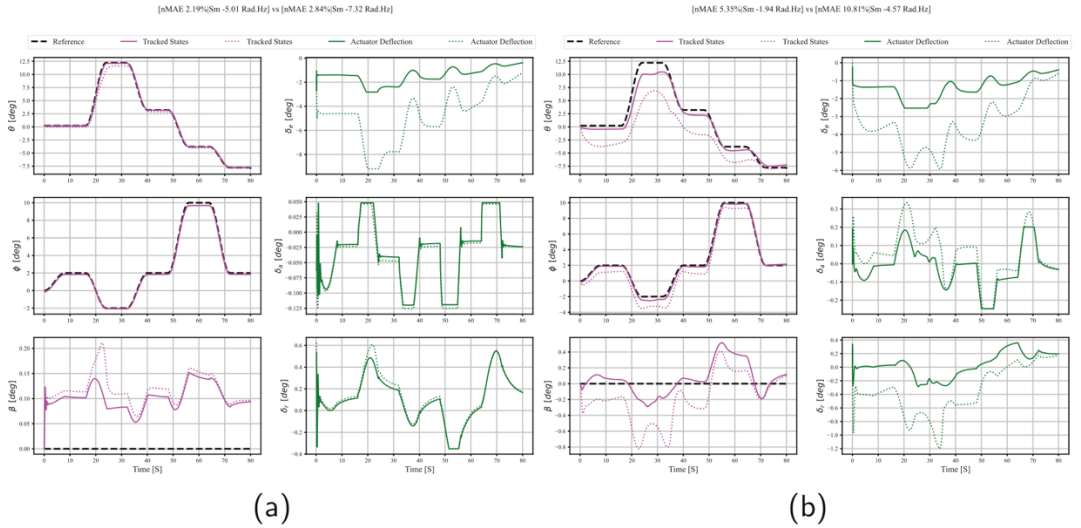


Fig. 5. A Normal Flight (straight line [-]) versus Flight with Partial Loss of Elevator (dotted line [·]) (a) PPO agent (b) CEM-TD3 Agent.

Projects and Research

Grads – (PhD)

Intelligent Aerospace Systems Lab (IASL)

Models and algorithms for design and operation of air transportation and aviation systems

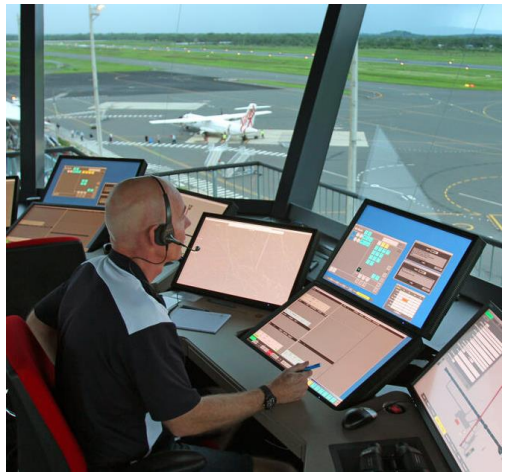
- Aircraft autonomy, multi-agent autonomy and human-autonomy teaming - **Autonomie des aéronefs, autonomie multi-agent et collaboration homme-autonomie**
- Aviation operations - **Opérations aériennes**
- AI safety and certification in aviation systems - **Sécurité de l'IA et certification des systèmes aéronautiques**

→

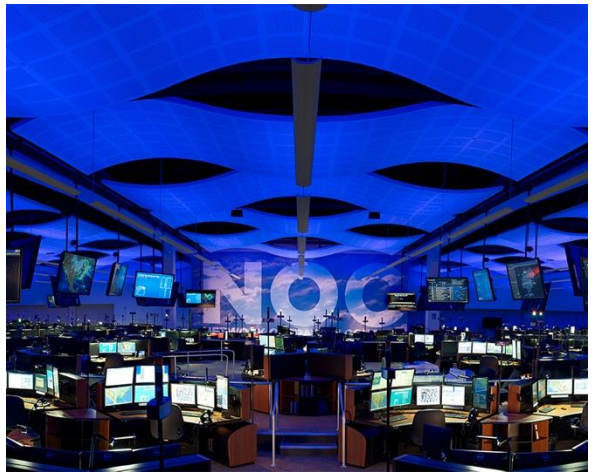
Applications:

- Urban Air Mobility (**Mobilité aérienne urbaine**)
- Air Traffic Control (**Contrôle du trafic aérien**)
- Advanced Air Mobility (**Mobilité aérienne avancée**)

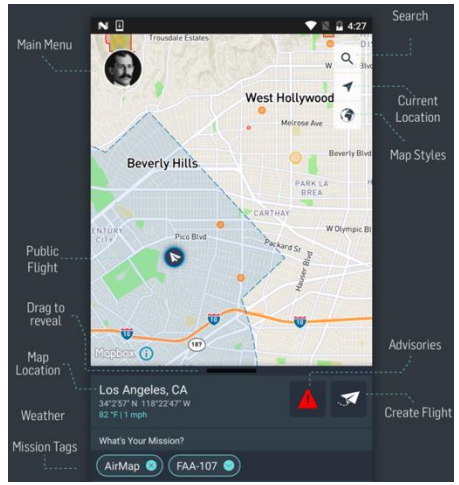
Methods: control, optimization, machine learning, artificial intelligence



Air Traffic Control/Management



Airline Operations



UAS Traffic Management

Electric Vehicle Prognostics

eVTOL Urban Air Mobility

Vertiport Operations

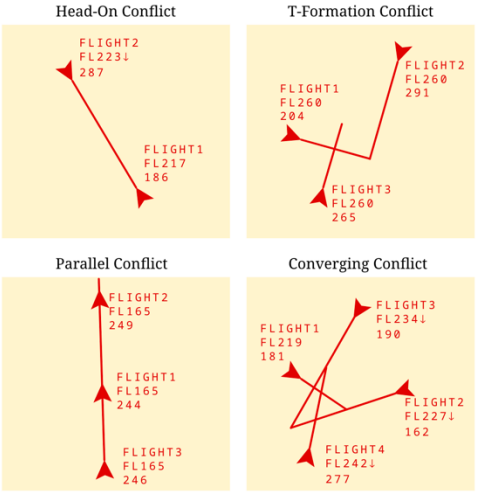
Projects and Research

Grads – (PhD)

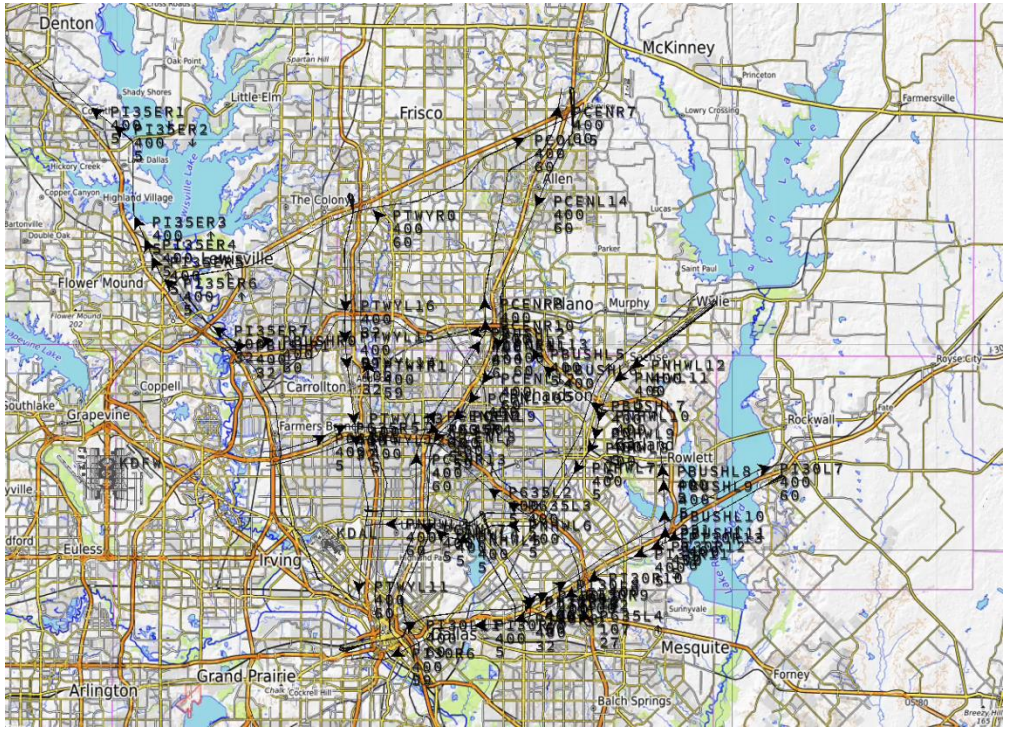
- Domaines:
  - Distributionally Robust Optimization (**Optimisation robustesse distributionnelle**)
  - Multi-Agent Reinforcement Learning (**Apprentissage par renforcement multi-agent**)
  - Deep Robust Reinforcement Learning (**Apprentissage profond par renforcement robuste**)

Motivation

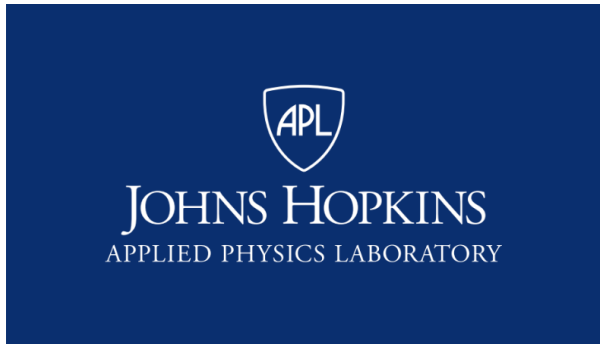
- Increased Traffic (**Augmentation du traffic**)
- Emerging Aircraft Transportation and Design (**Transport aérien émergent et conception des aéronefs)**
- Recent Collisions (**Collisions récentes**)

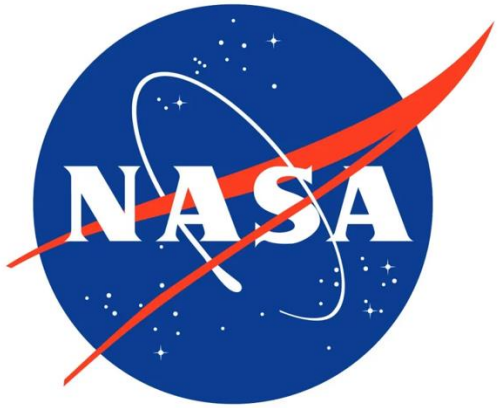


Credits: Peng Wei, PhD - Marc Britain, PhD - Shulu Chen, PhD



Lab Collaborations





Extra:

- Safe and Responsible AI workshop, (FAA, HASS COE, Johns Hopkins APL and MIT Lincoln Labs, TRAILS, NIST AI, RAIUK), September 2024
- System-Wide Safety Technical Challenge Research Overviews Workshop, April 2025
- Peer Reviews
  - Reviewer for the International Conference on Guidance Navigation and Control (ICGNC 2024)
  - Journal of Aerospace Information Systems, AIAA, 2025
- Teaching Assistant: Linear Systems Dynamics, MAE 3134, 2025

Suggestions domain specialization

- Aerodynamics (Aerodynamique)
- Structures
- Design
- Manufacturing (Fabrication)
- Electronics/Avionics/hardware
- Control / Computer Science
- Propulsion

Conclusion

- Be **focus**

- Keep imagining / building / creating / practicing (**Continuez à imaginer / construire / créer / pratiquer**)

- Go deeper into concepts / to the bottom of it / Ask questions (**curiosité)**
- Build a Network / Collaborate (**Créez un réseau / Collaborez**)

- Pass down knowledge (**Partagez vos connaissance**)

- **Enjoy !!!!!**

Q & A