
INNOVATION
FAIR
12
14
MARCH
2024

My Thesis in 180 Seconds

Gladys Mercan

Associate Innovation Officer, ICAO

Panel Speakers

Bogdan Bogachov

Mc Gill University

Sabrina Marie Knappe

Mc Gill University

Corentin Conan

Mc Gill University

Josh Chang

Mc Gill University

Syed Shabbir Ahmed

Mc Gill University

Bogdan Bogachov

Mc Gill University

Use of Large Language Models in Aerospace Engineering

Department of Mechanical Engineering
Additive Design and Manufacturing Lab
Bogdan Bogachov, PhD student
Prof. Yaoyao Fiona Zhao, supervisor

McGill ADML

Oversimplified communication example between aircraft operator and aircraft manufacturer

Aircraft operator request

An operator requested a repair procedure for a corrosion damage on a skin panel between stringers 14L and 15L & frames 21 and 22 in the pocket area. Corrosion is within 3” x 3” boundary. The nominal skin thickness is 0.050”, the remaining minimum skin thickness is 0.045”.
Provide a repair instruction for this damage.

Aircraft manufacturer response

1. Remove corrosion per SRM chapter XXX.
    A. Do not deepen damage beyond minimum remaining thickness reported.
    B. Do not blend over fastener heads. If not possible, remove fasteners.
2. If fasteners removed, perform a detailed visual inspection of all open fastener holes in damage area to confirm there is no corrosion per SRM chapter XXX.
3. If necessary, adjust fastener countersink per SRM chapter XXX.
4. If fasteners removed, re-install same as original per baseline drawing and SRM chapter XXX.
5. Restore finish of reworked areas to XXX finish per SRM chapter XXX.

Is there a problem in this kind of communications?

Time.

It takes a lot of time to prepare this kind of documents, thus, we could try reducing time to prepare engineering documentation for operators.

How?

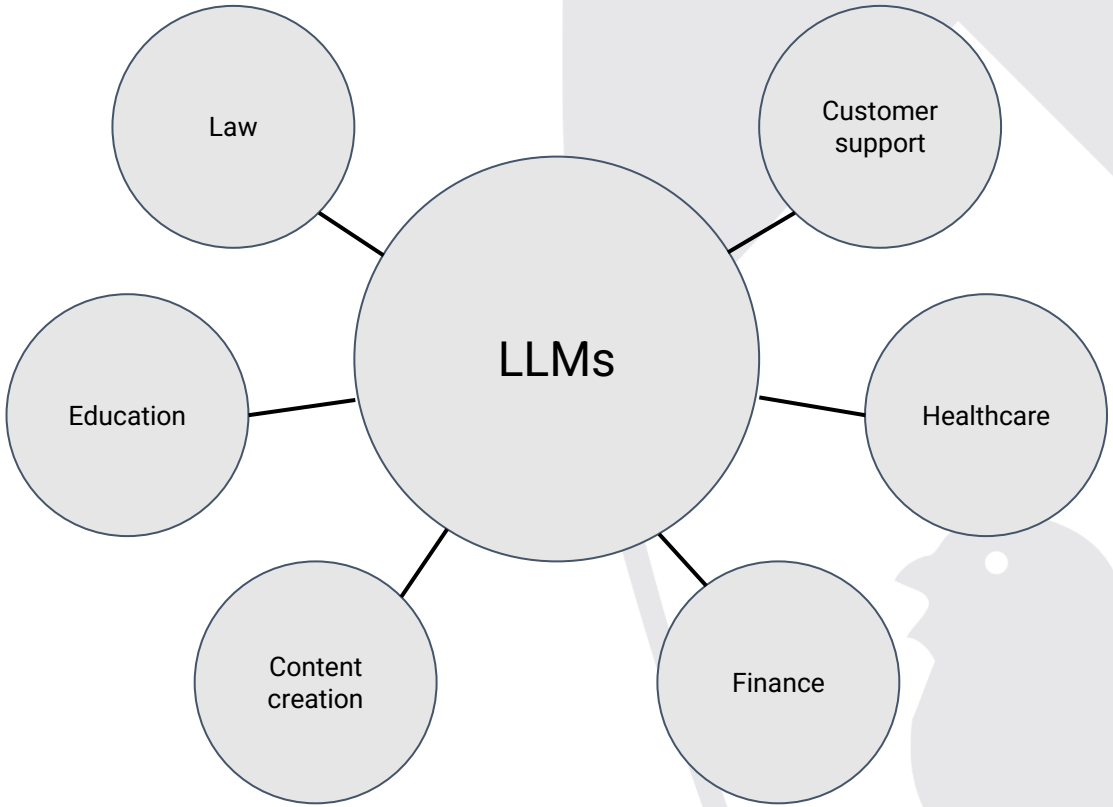
What are Large Language Models (LLMs)?

An LLM is a type of AI system that has been trained on a vast amount of text data and can understand and generate human-like text.

One of the most prominent examples is ChatGPT.

Image Source: Stephen Berg, https://enterprise-knowledge.com/what-is-a-large-language-model-llm/, 2024

Where are LLMs used?



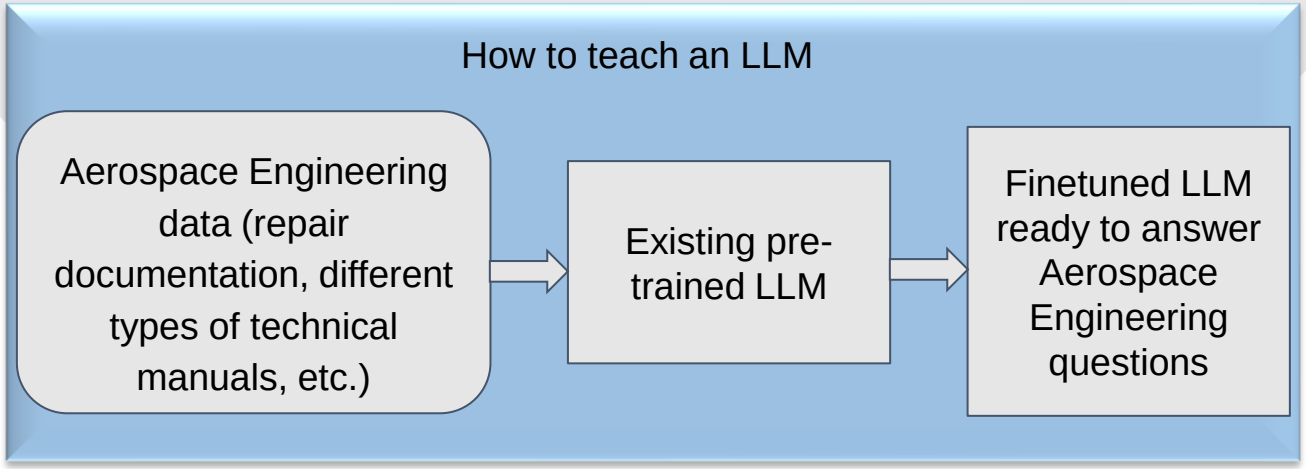
Example:

User: Please tell me which software is used more commonly in aerospace industry to build 3D models of aircraft. Limit your answer to one sentence.

ChatGPT: In the aerospace industry, CATIA, SolidWorks, and Siemens NX are commonly used software for building 3D models of aircraft.

How can LLMs be applied in aerospace industry and what are the benefits?

LLMs should be capable of generating domain specific text for aerospace industry. For instance, **structural (or any other) repair instructions**.

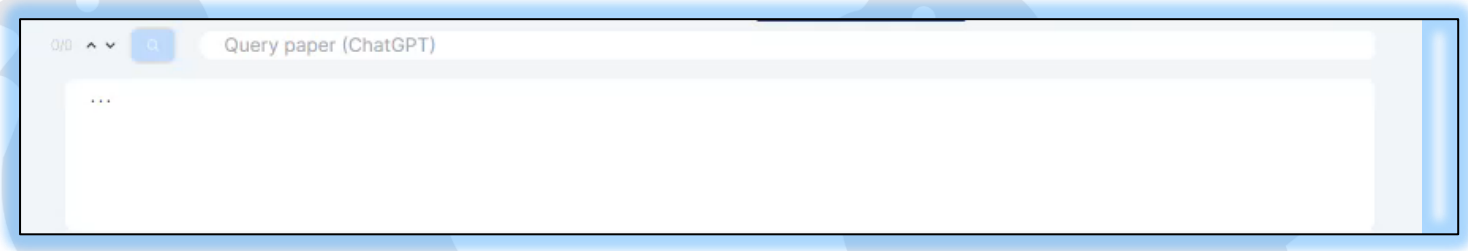


Benefits:

- Could save time and resources.
- Could mitigate engineering errors.

Challenges:

- Lack of training data.
- Potential problems with model accuracy and hallucinations.
- Data security has to be guaranteed.



Thank you for attention!

For more information, please contact:
bogdan.bogachov@mail.mcgill.ca
yaoyao.zhao@mcgill.ca

Sabrina Marie Knappe

Mc Gill University

Transforming pilot-ATC communications for effective navigation

Controller Pilot Data Link Communications (CPDLC) will see increased usage as a result of changing paradigms in airspace. The advent of Trajectory Based Operations (TBO), single pilot operations, and remote piloted aircrafts will increase demand on CPDLC, which can reduce load on overcrowded very high frequency (VHF) radio. The third generation of CPDLC interfaces must account for these changes and provide a bridge between current and future operation paradigms. I am investigating how a near-term improvements can be made to CPDLC to increase situational awareness and reduce efficacy and error, and how long-term improvements can be made to the flight deck to streamline navigation and communication tasks into a more integrated workflow.

Sabrina Knappe
PhD Candidate, McGill University

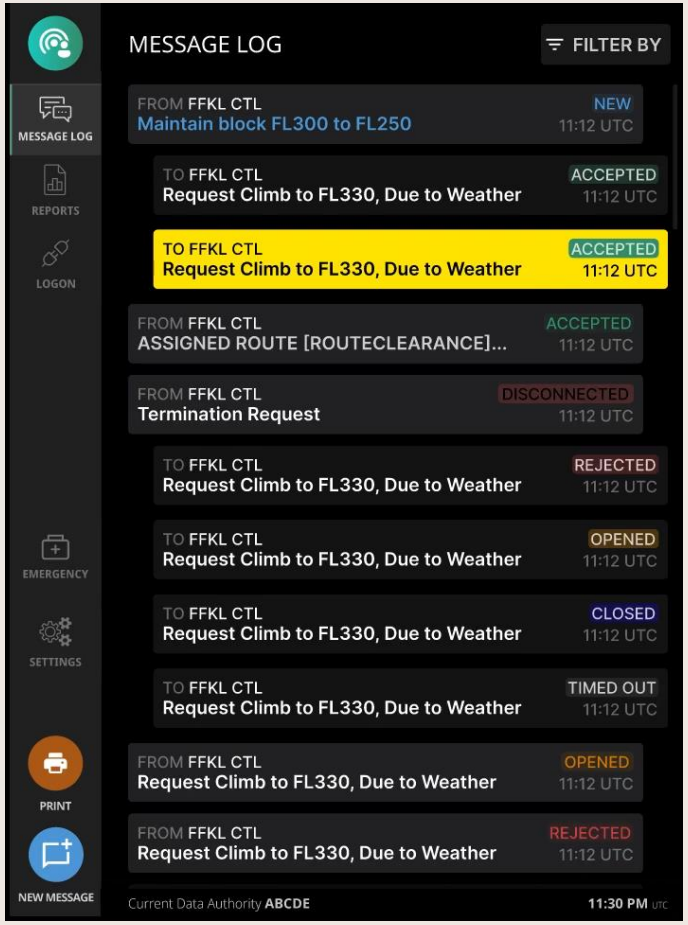

TUNE
DLK
CPDLC
GWX
MSG LOG
SETTINGS ▼
REQUEST ▼
REPORT ▼
LOGON/STATUS
NETWORK FANS 1/A
ATC DL
ENABLED ▼
SETTINGS ▼
LOGON
ADS
EMERGENCY
SYSTEM INFO
SETTINGS MENU
REQUEST ▼
ALTITUDE
OFFSET
SPEED
ROUTE
CLEARANCE
VMC DESCENT
WHEN CAN WE
VOICE REQ
FREE TEXT
MONITORING
REQUEST MENU
REPORT ▼
POSITION REP
REPORTS DUE
REPORT MENU

Making CPLDC Future-ready

- Increased mandatory coverage
- Increased and diverse air traffic
- Trajectory-based operations
- Single pilot operations

Putting it all together

Original Design



Redesign 1

Redesign 2

Corentin Conan

Mc Gill University

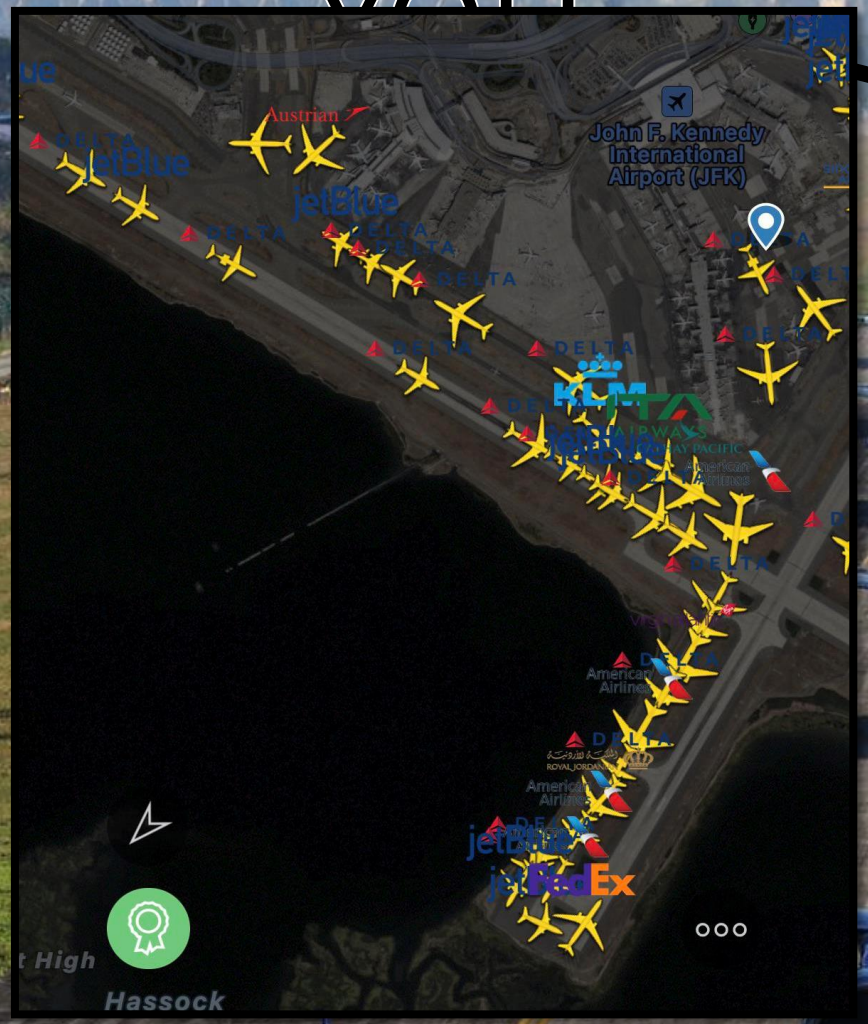
Making Surface Trajectory-Based Operations possible from a pilot's standpoint

Corentin Conan – McGill University

McGill

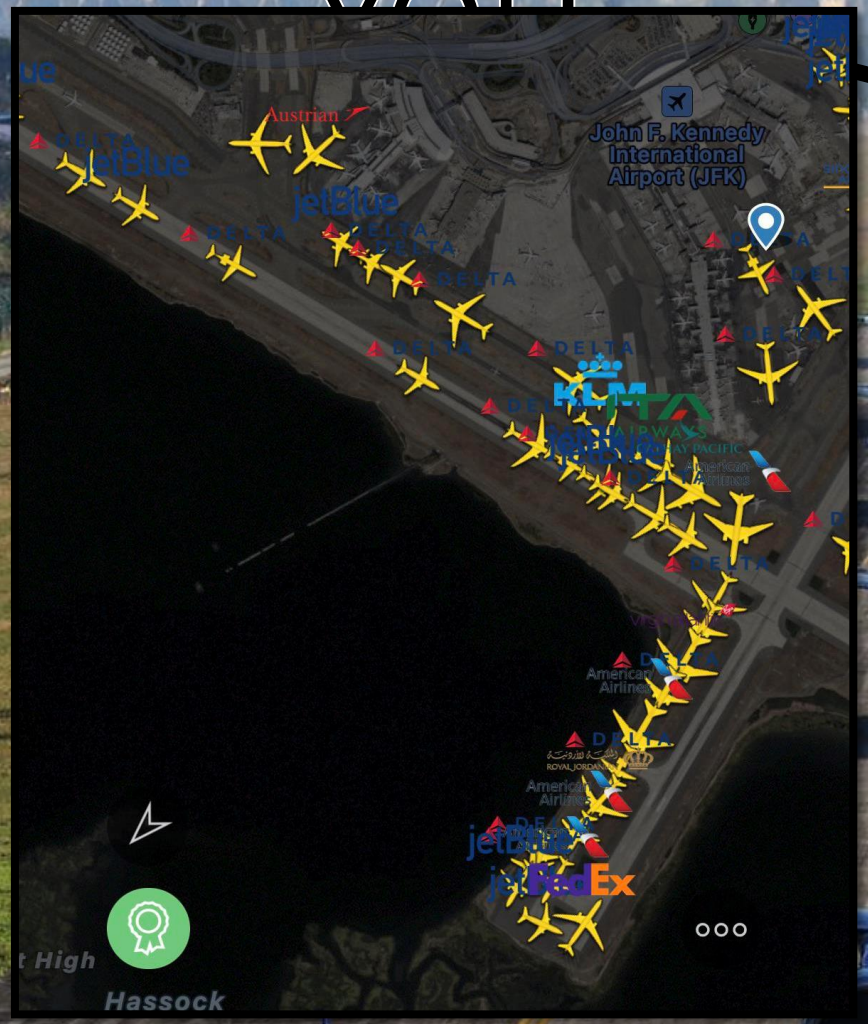

YOU

YOU

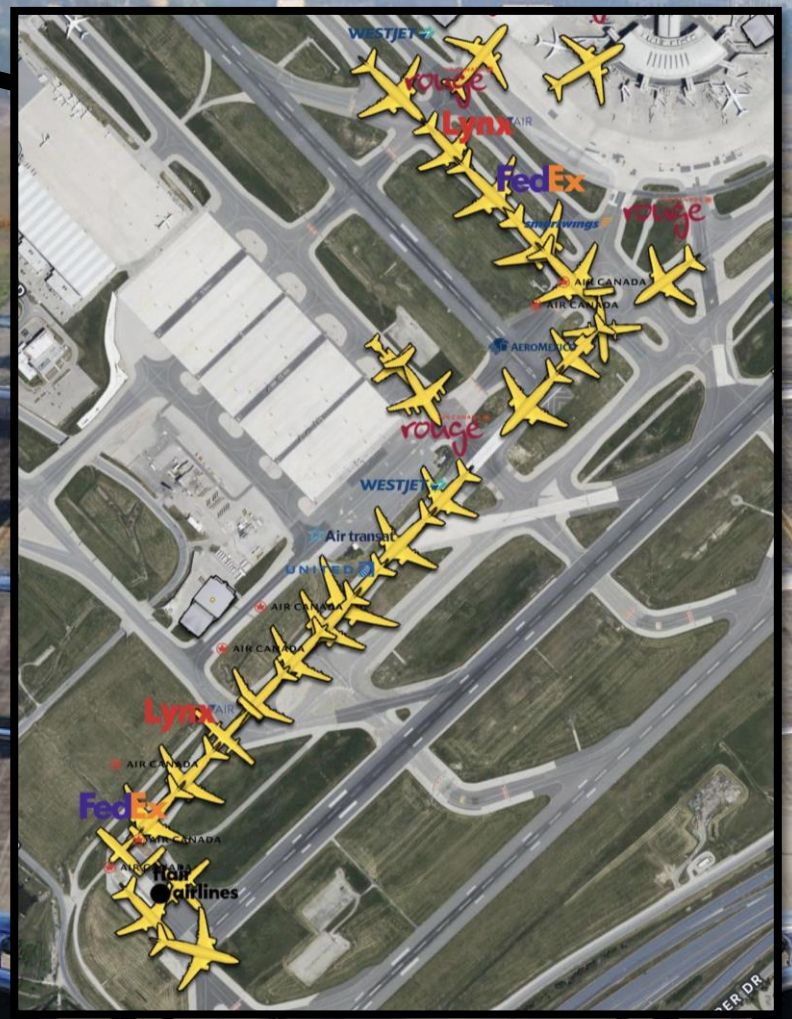

Austrian
John F. Kennedy International Airport (JFK)
DELTA
jetBlue
KLM
FedEx
American Airlines
Hassock

KJFK

YOU

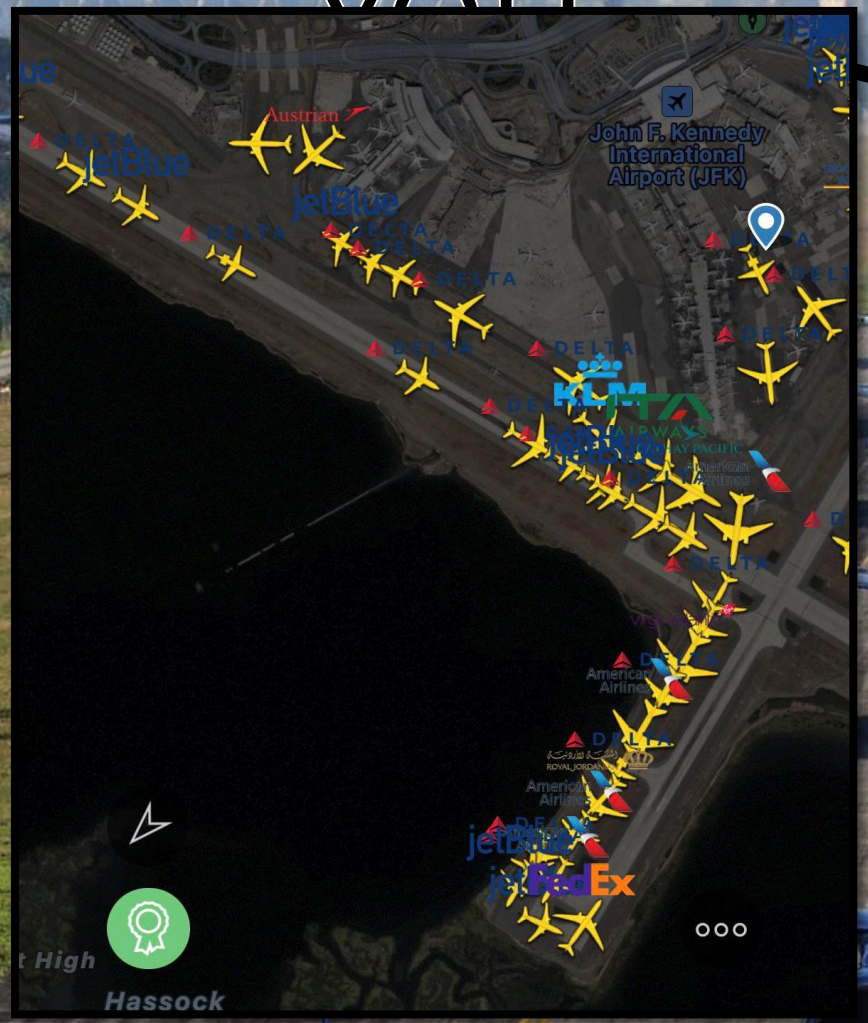


KJFK

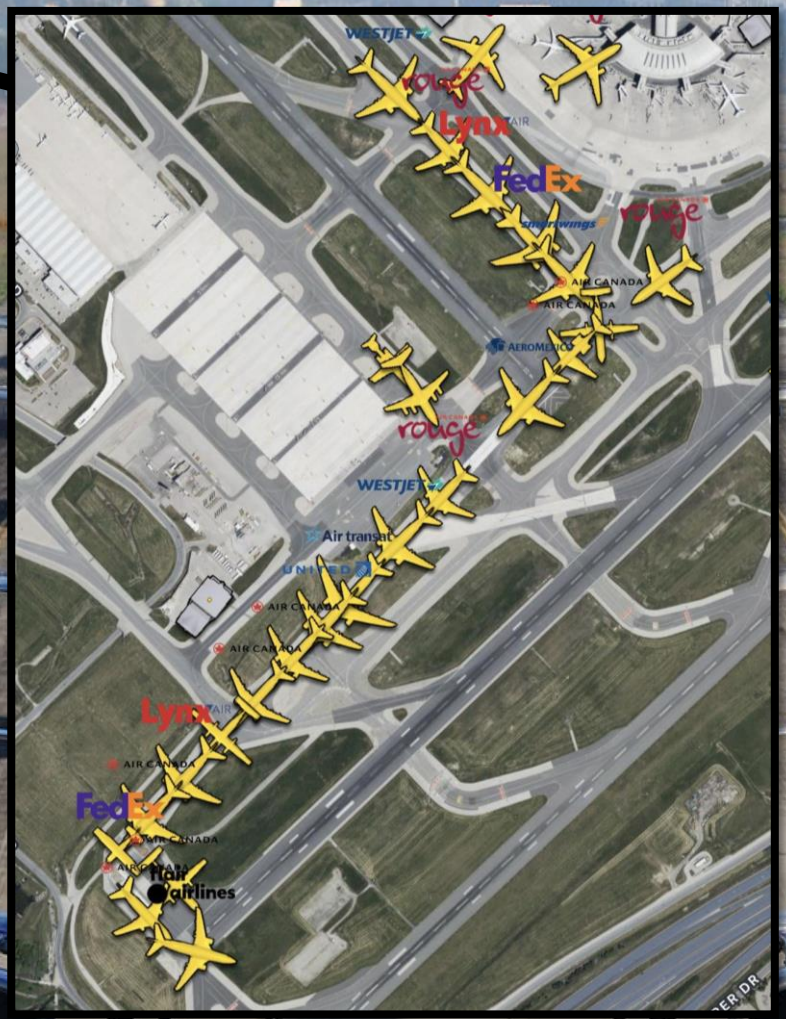


CYYZ

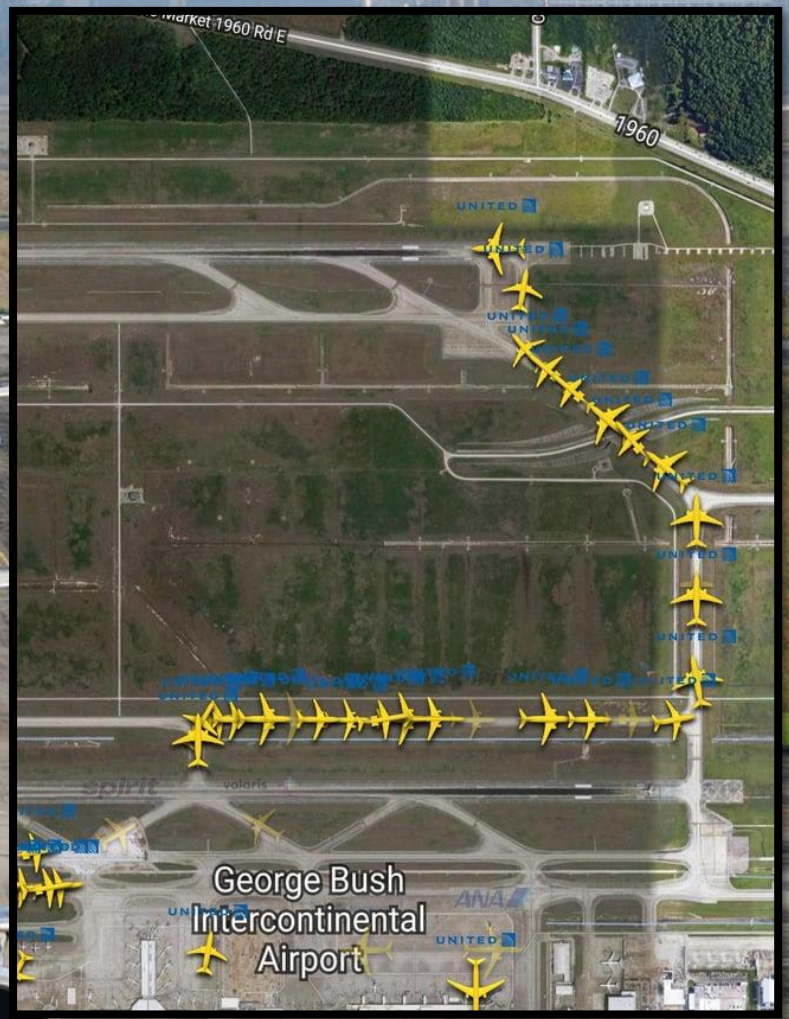
YOU



KJFK



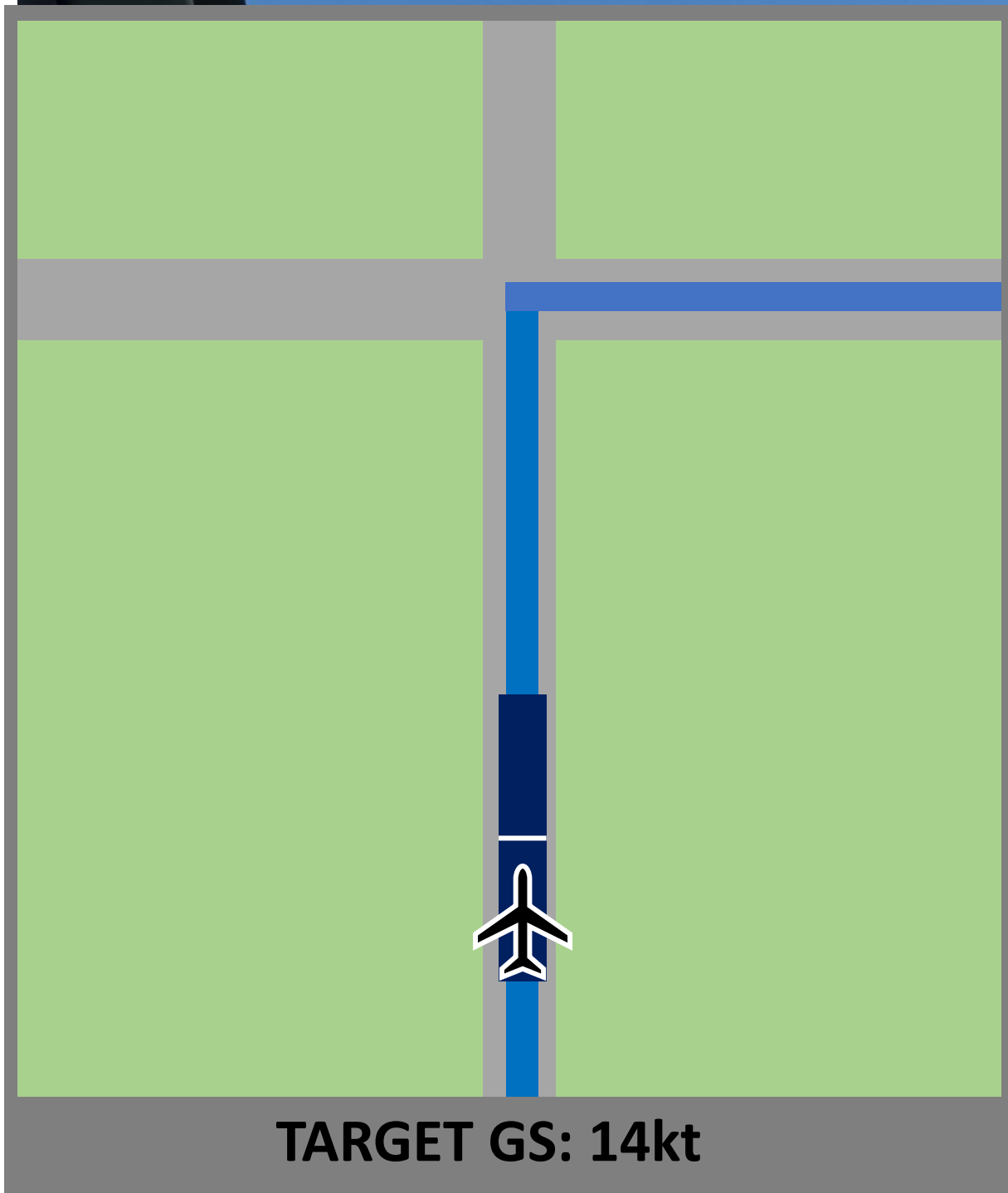
CYYZ



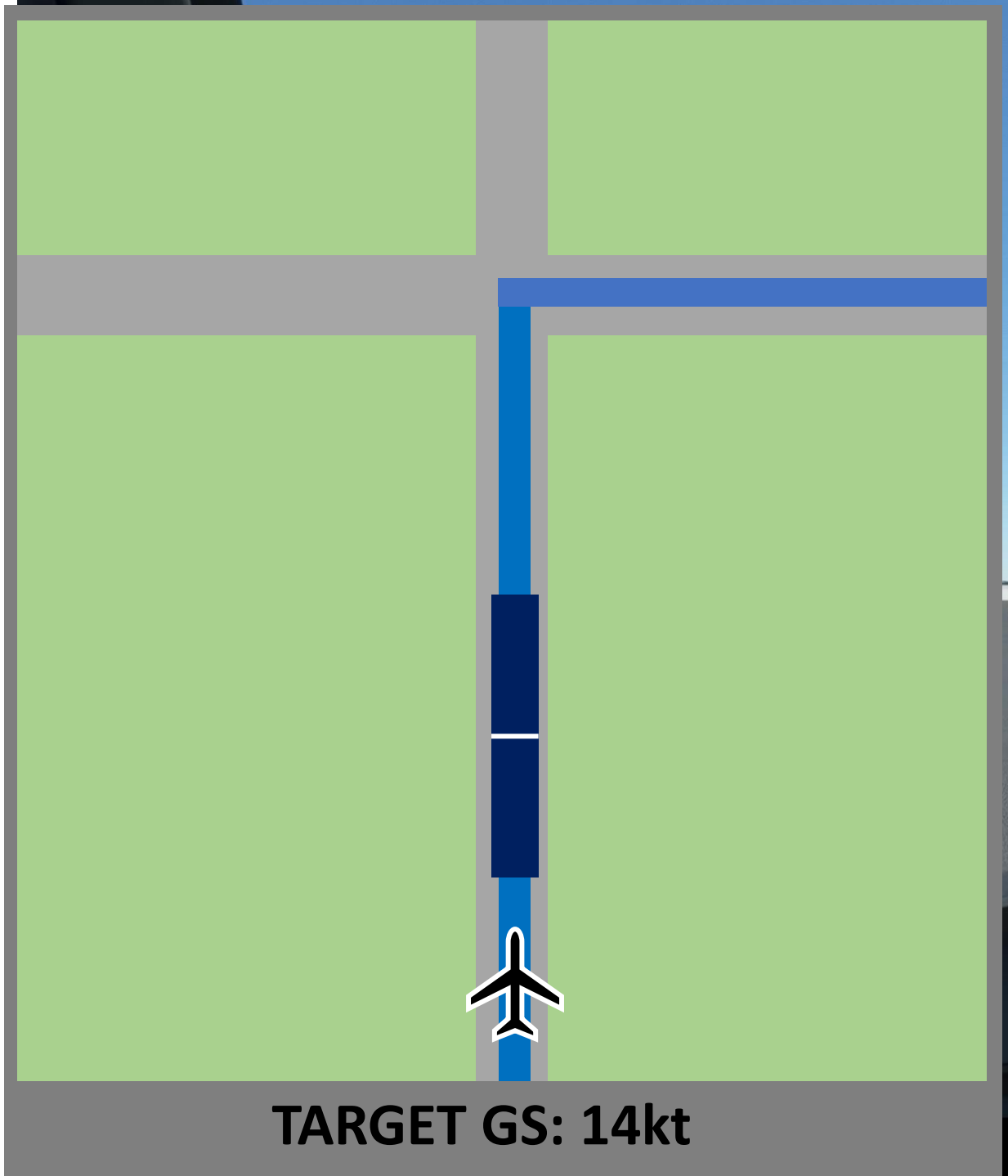
KIAH


Cross C in **34s** at **15kts**
Stop at K4 in **56s**
Taxi on L at **23kts**
And get to M by **13:09:13**


Cross C in **34s** at **15kts**
Stop at K4 in **56s**
Taxi on L at **23kts**
And get to M by **13:09:13**

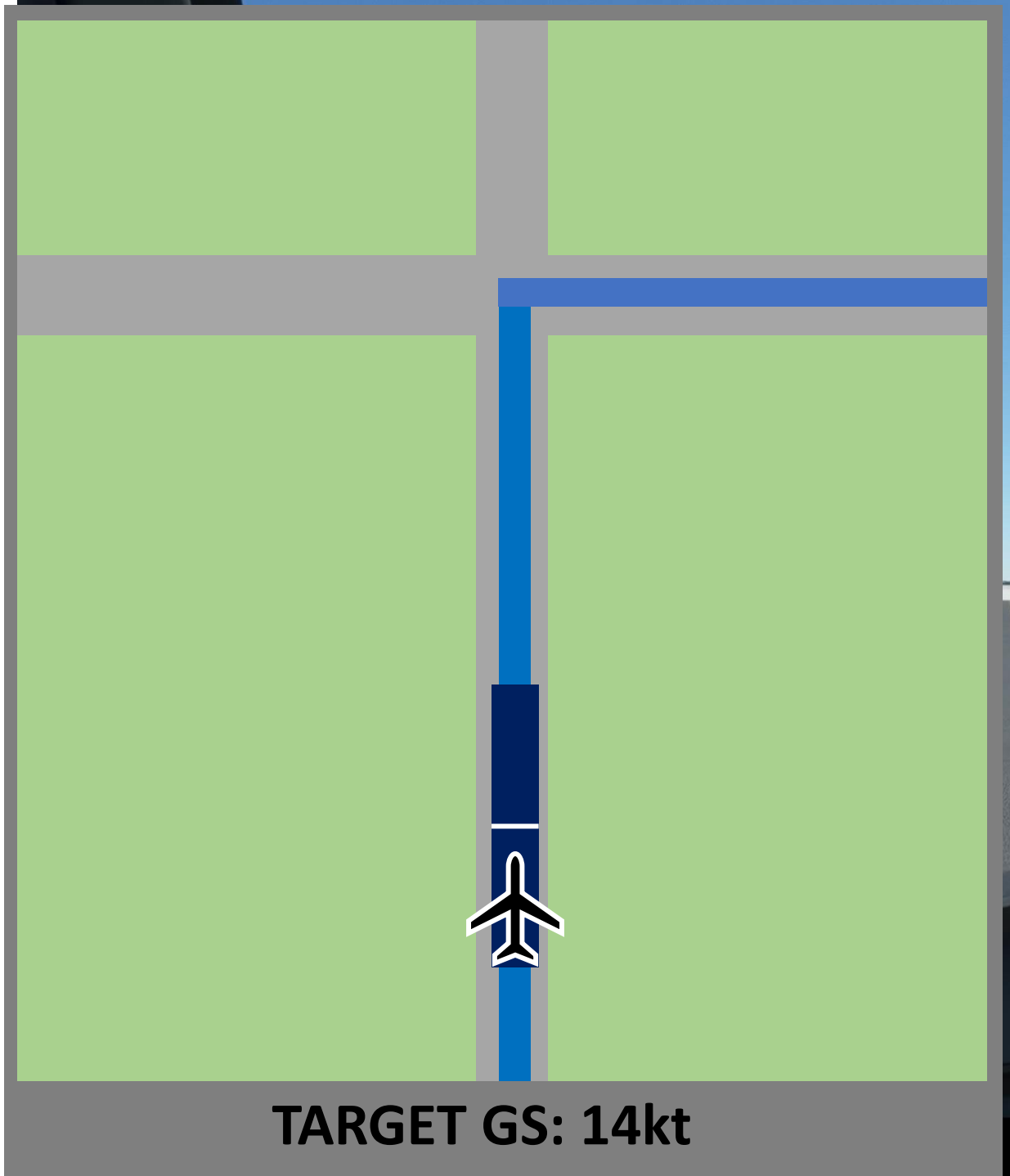


TARGET GS: 14kt

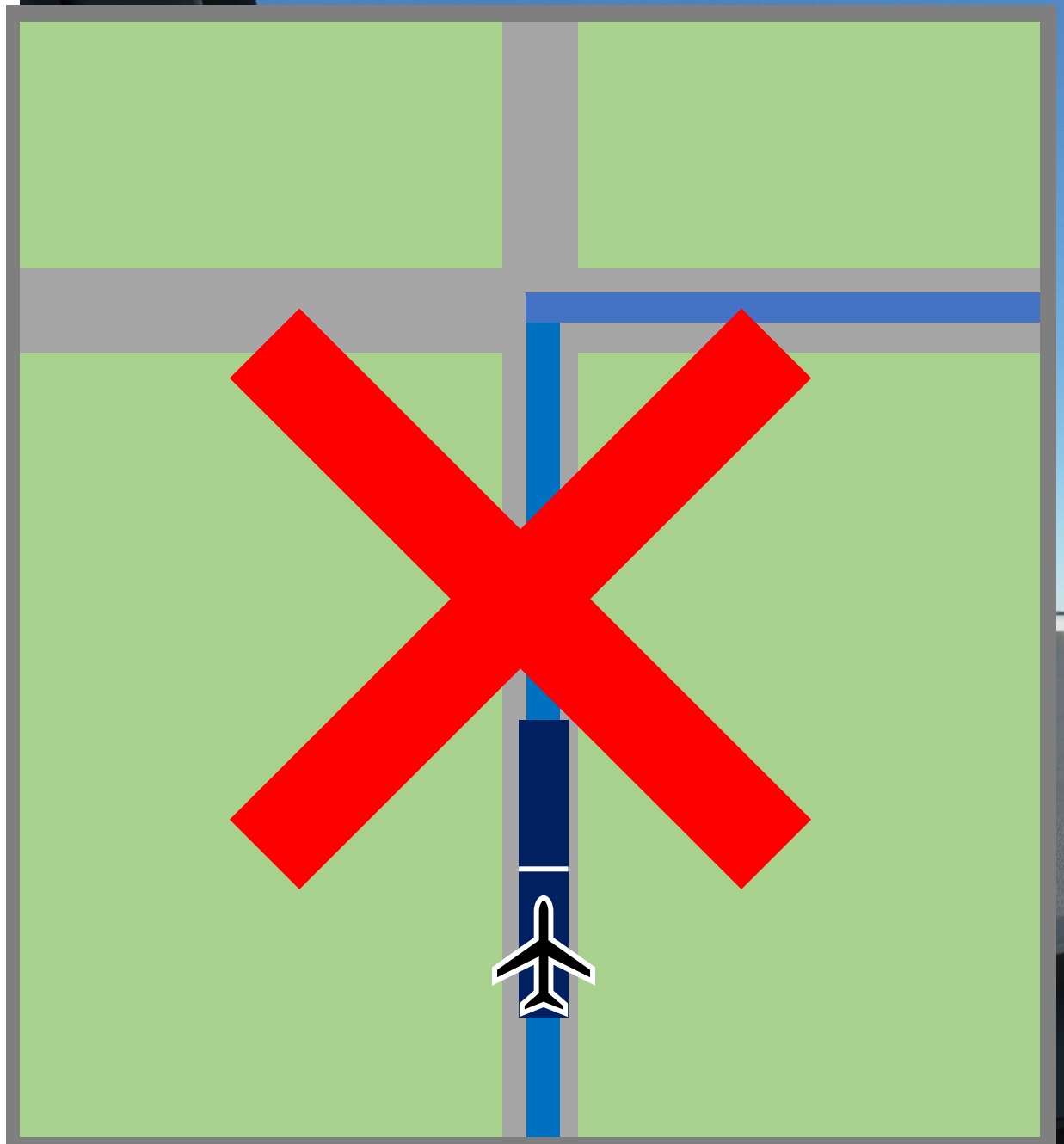


TARGET GS: 14kt

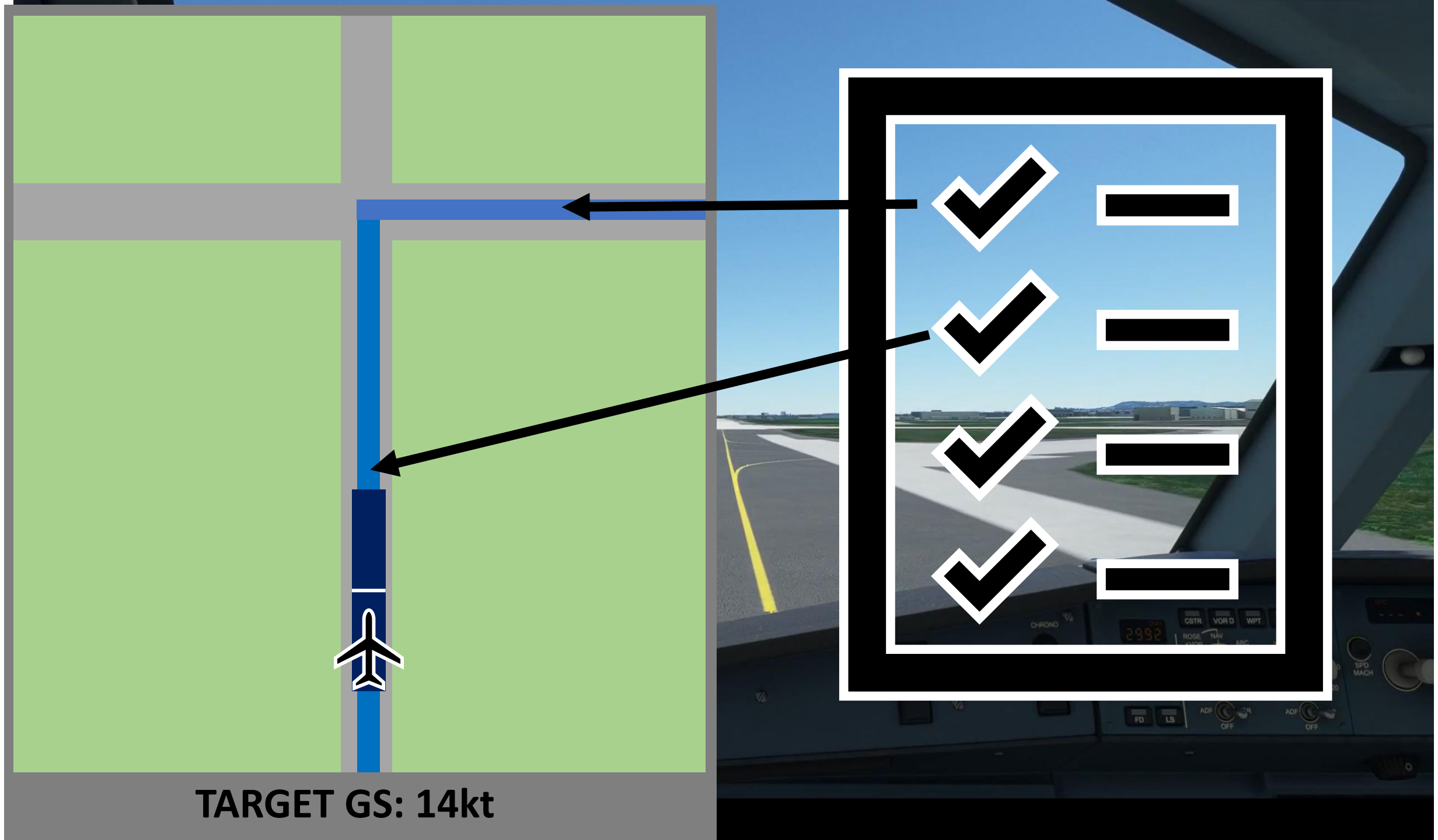
SPEED = WORKLOAD MANAGEMENT



TARGET GS: 14kt



TARGET GS: 14kt


TARGET GS: 14kt

Josh Chang

Mc Gill University

Automating Aircraft Component Placement in Multidisciplinary Design Optimization

Josh Chang

McGill University

Supervised by: Prof. Michael Kokkolaras
@ Systems Optimization Laboratory

Funded by and in collaboration with

NSERC CRSNG

CRIAQ

BOMBARDIER

Université Concordia University

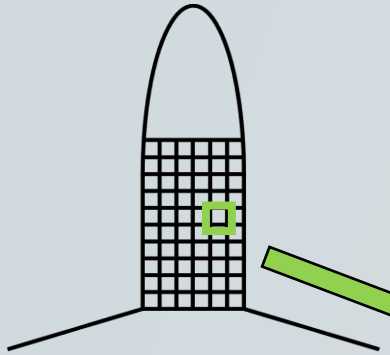
MTLS aerostructure

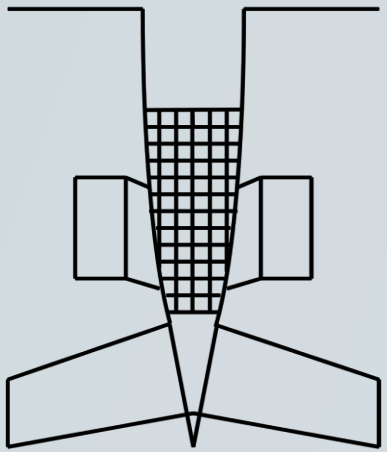
STREAM

1) Assist Conventional Design

2) Implement Novel Systems

3) Conceptualize New Airframes





1) Aircraft

Fire

Electrical

Hydraulic

Keep Empty

2) Type of Object

Maintenance

Thermal

Safety

Weight

3) Considerations

Thank you!

Email: josh.chang@mail.mcgill.ca

Syed Shabbir Ahmed

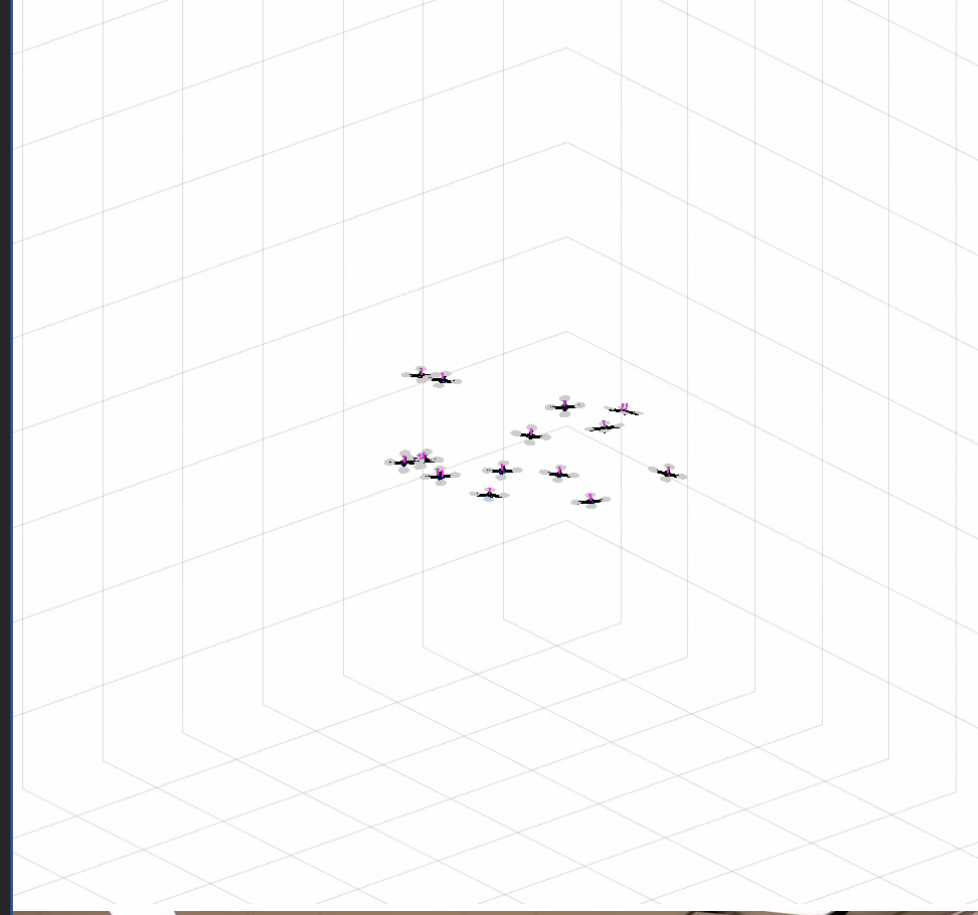
Mc Gill University

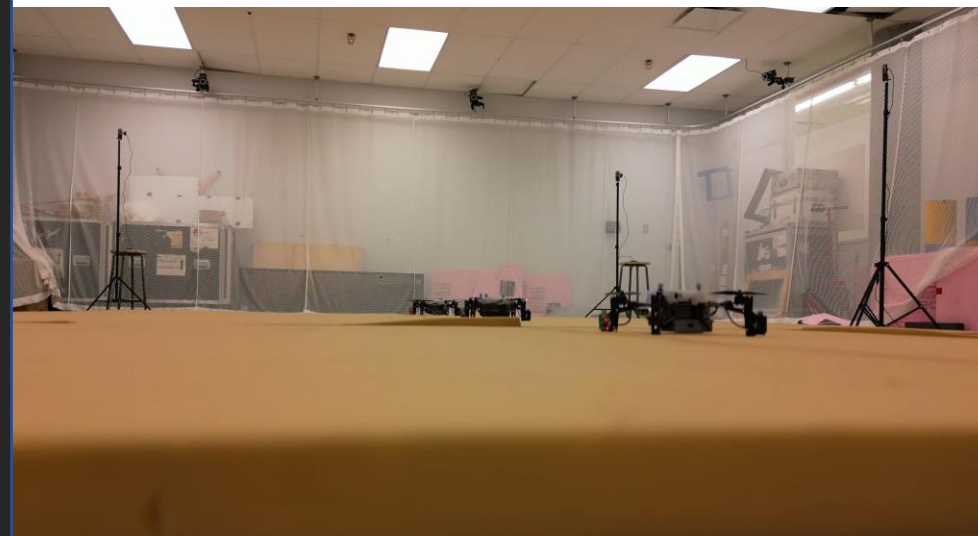
OPTIMAL ROBOT FORMATIONS:

BALANCING RANGE-BASED OBSERVABILITY AND USER-DEFINED CONFIGURATIONS

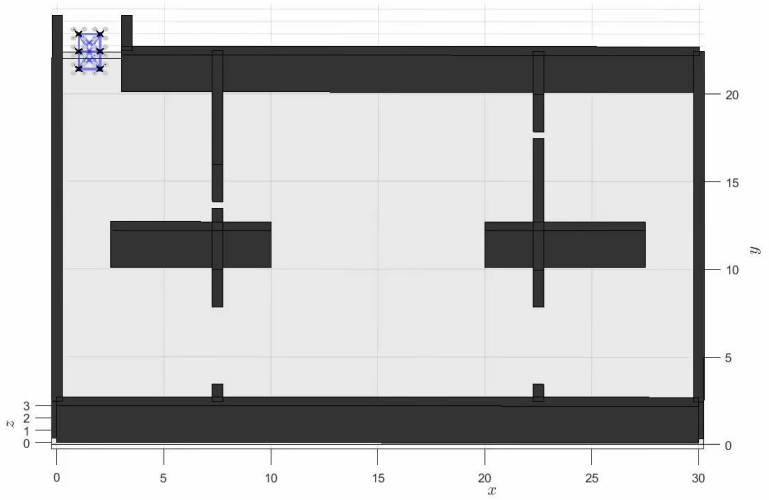
Syed Shabbir Ahmed

Supervised by James Richard Forbes

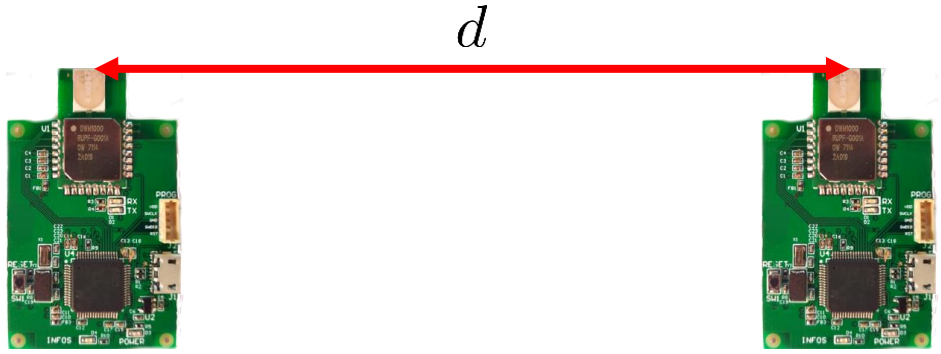




Collaborative exploration and mapping

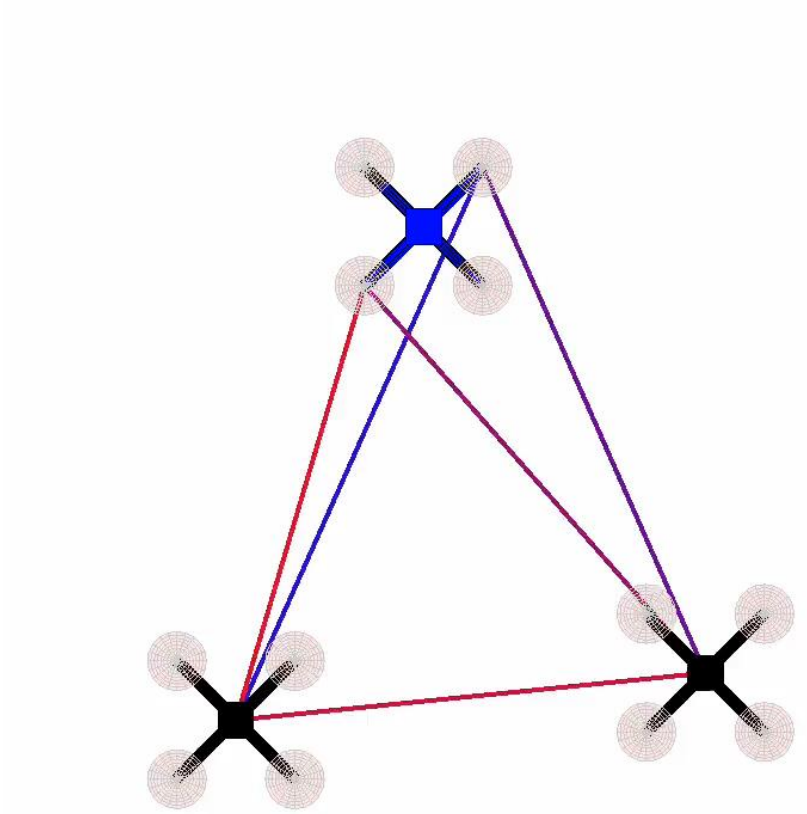


Where am I ?

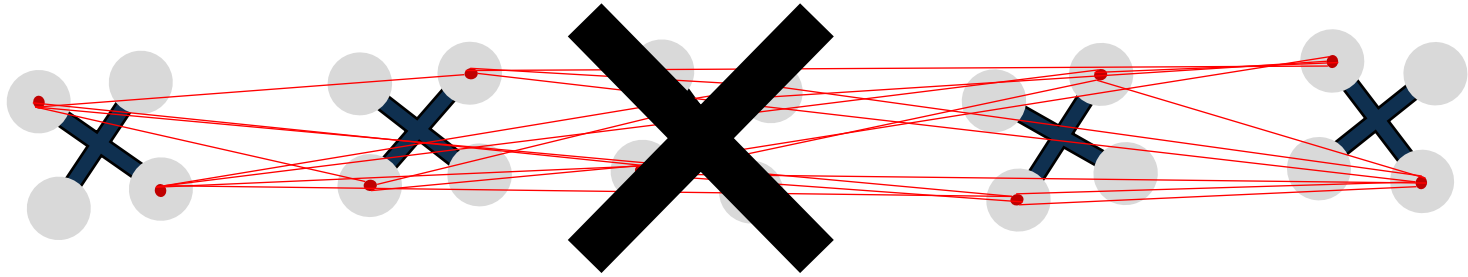


Ultra-wideband Radio:

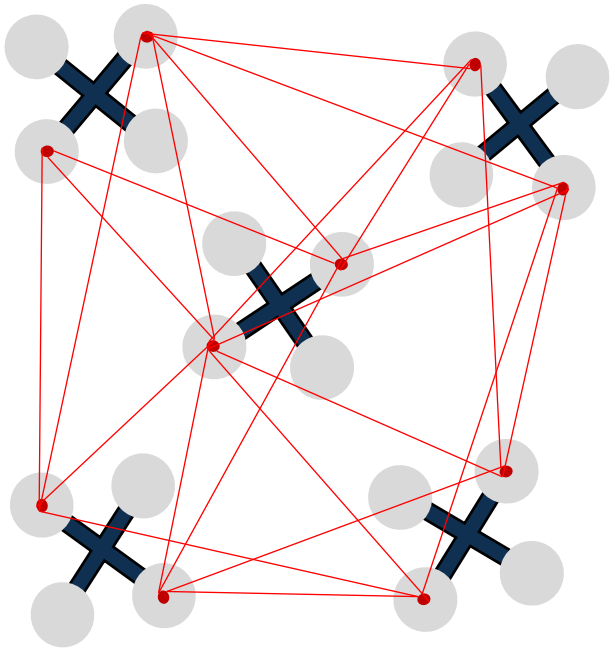
- Cheap, Small (Lightweight), Low power



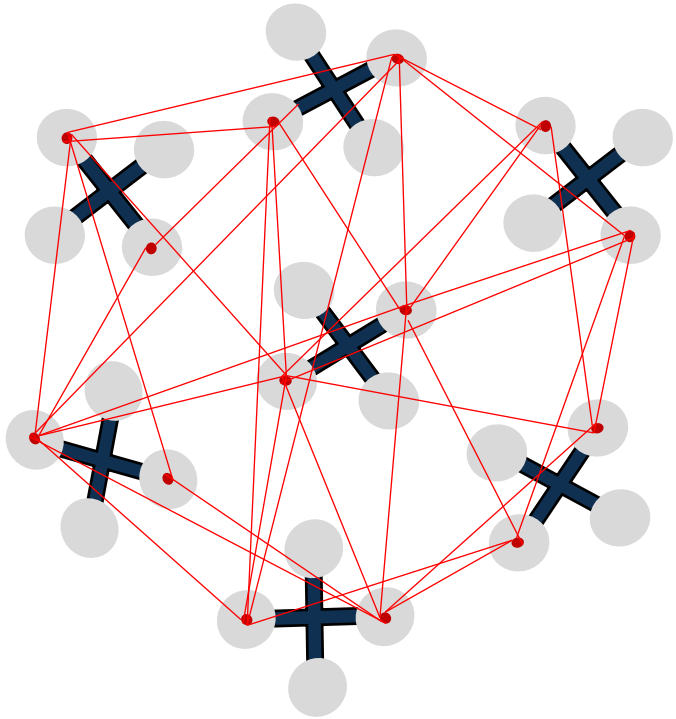
Optimal Robot Formations



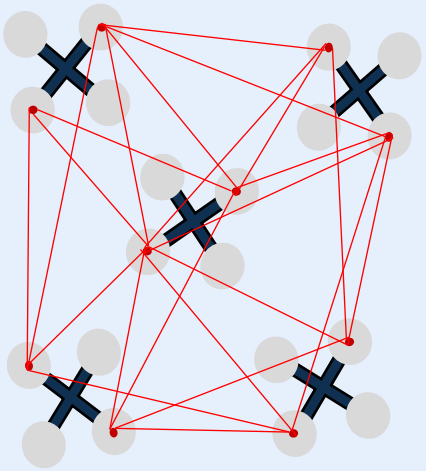
5 Robots



7 Robots



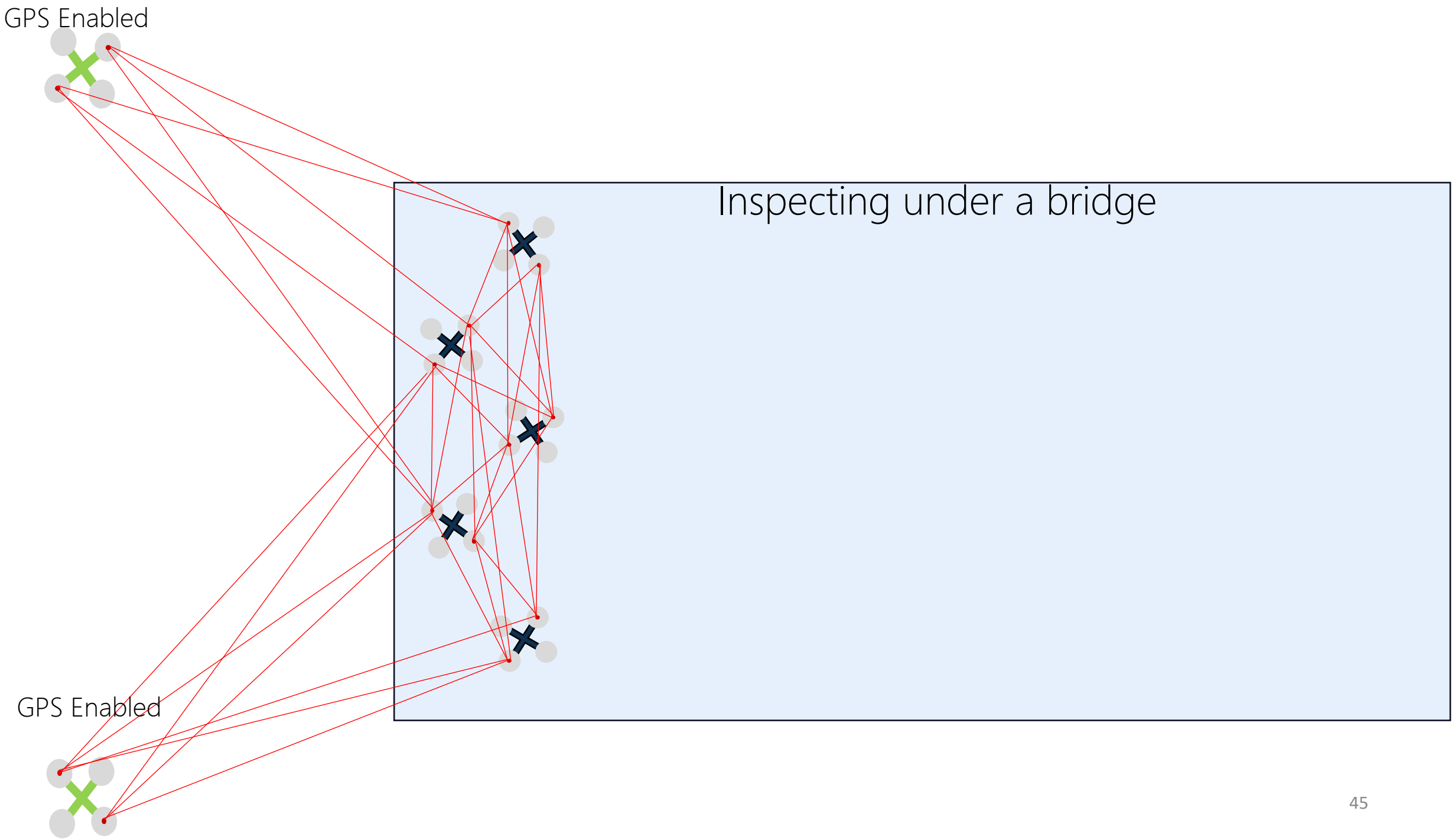
Optimal Robot Formations



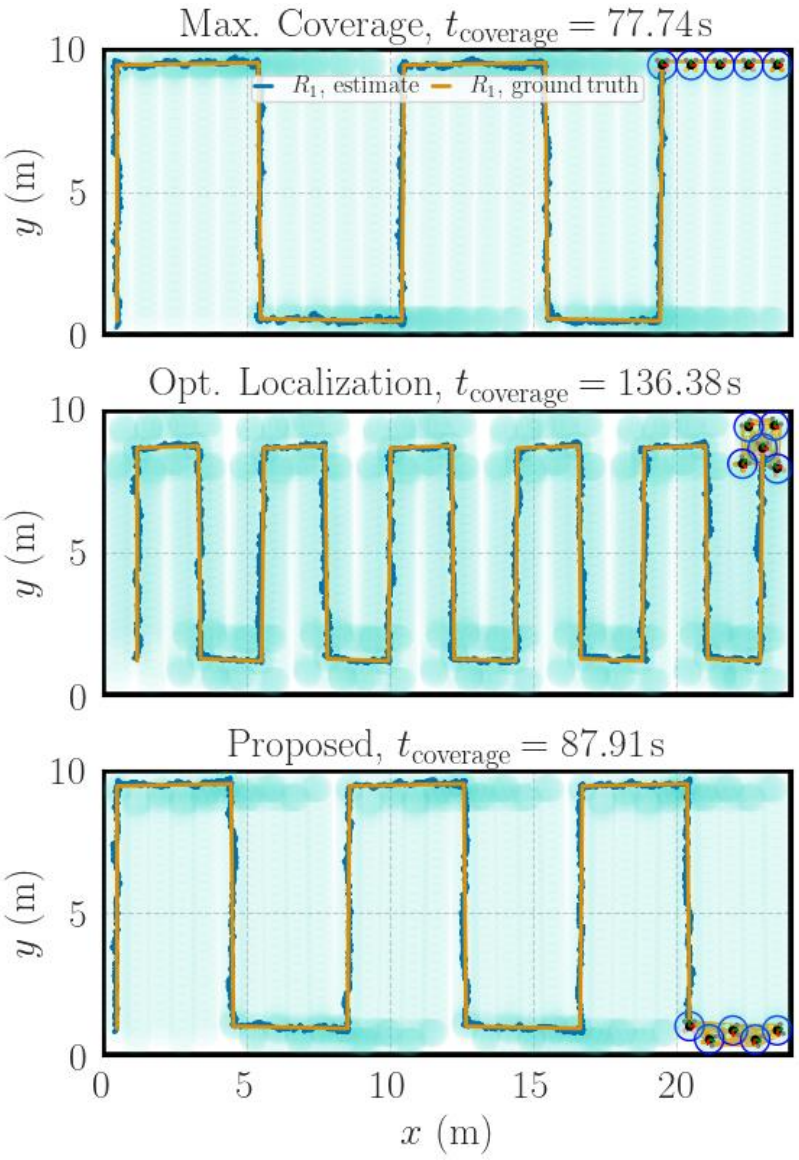
Research Outcome

Minimize a cost function C to get a variety of

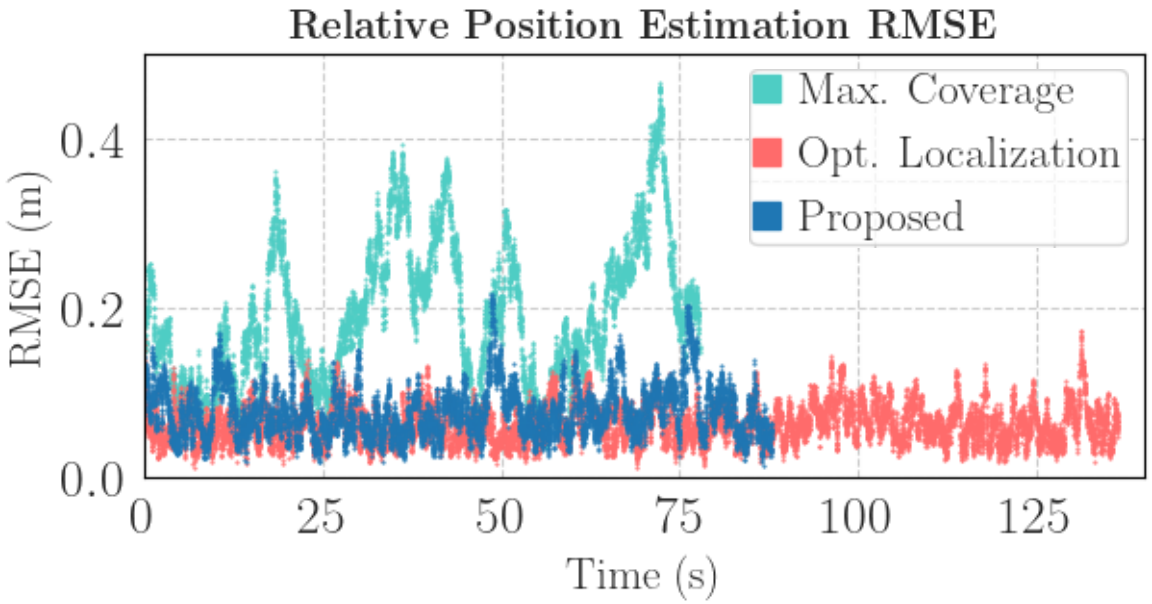
- high-coverage formations
- with good relative position estimation accuracy


GPS Enabled
Inspecting under a bridge
GPS Enabled

Simulation



Extended Kalman Filter:



Acknowledgement

Prof. James Forbes

Mohammed Shalaby

Charles Cossette

Thank You

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