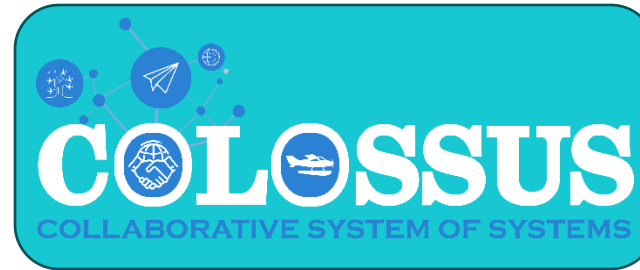


The Large Language Model Pilot

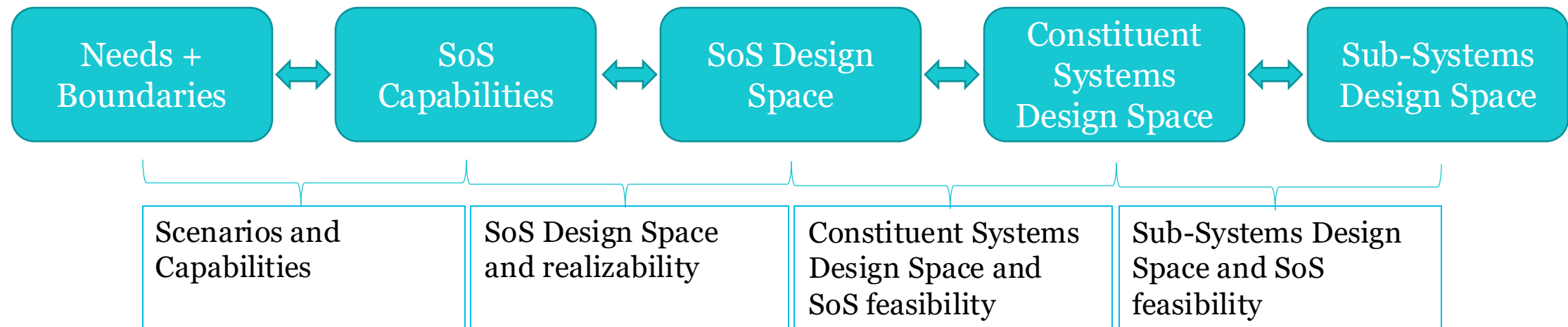
Generative Artificial Intelligence for Cyber-
Physical Flight Simulations

Jorge L. Lovaco PhD Candidate

Background



- Systems of Systems Analysis: A holistic view for design space studies



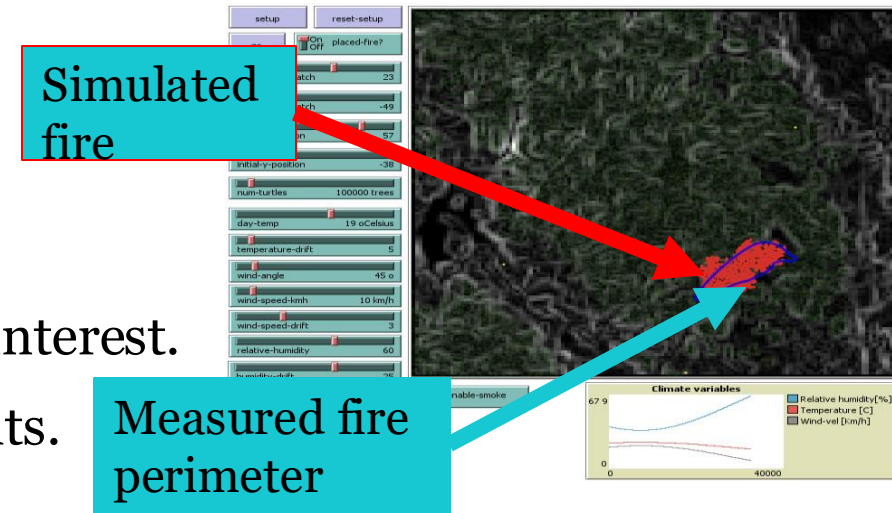
- Goals:

- Better use of current systems
- Aircraft conceptual design -> Requirements



Previous work & Motivation

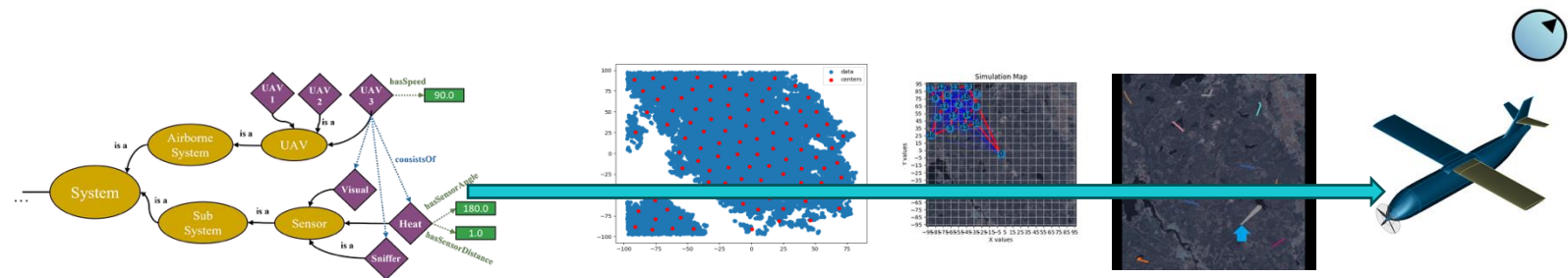
- A good representation of environment.
- Use the fire model and methods for finding it over the area of interest.
- Wildfire suppression operation with Generative-AI based agents.



• Why LLM-Pilot

- Are they feasible for modelling & simulation?
- Are they mature for modelling & simulation?
- Challenges Addressed:

- Communication
- Decisions

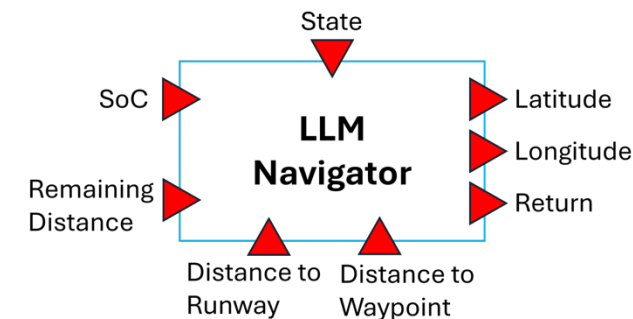
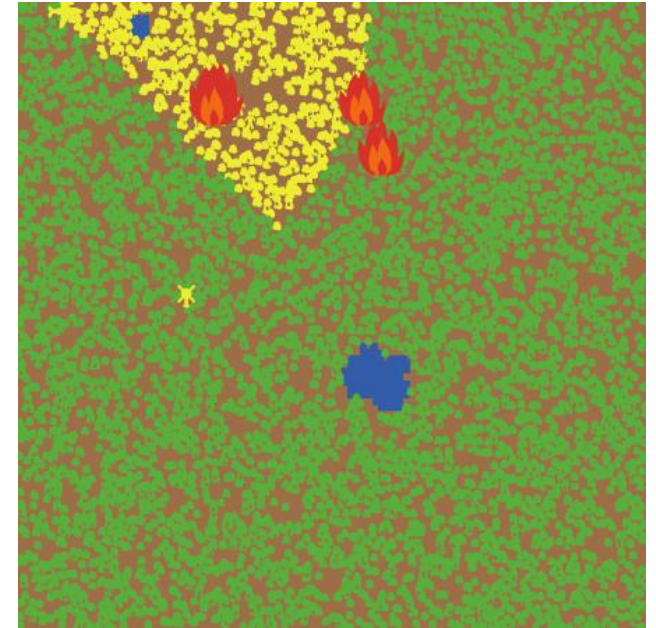


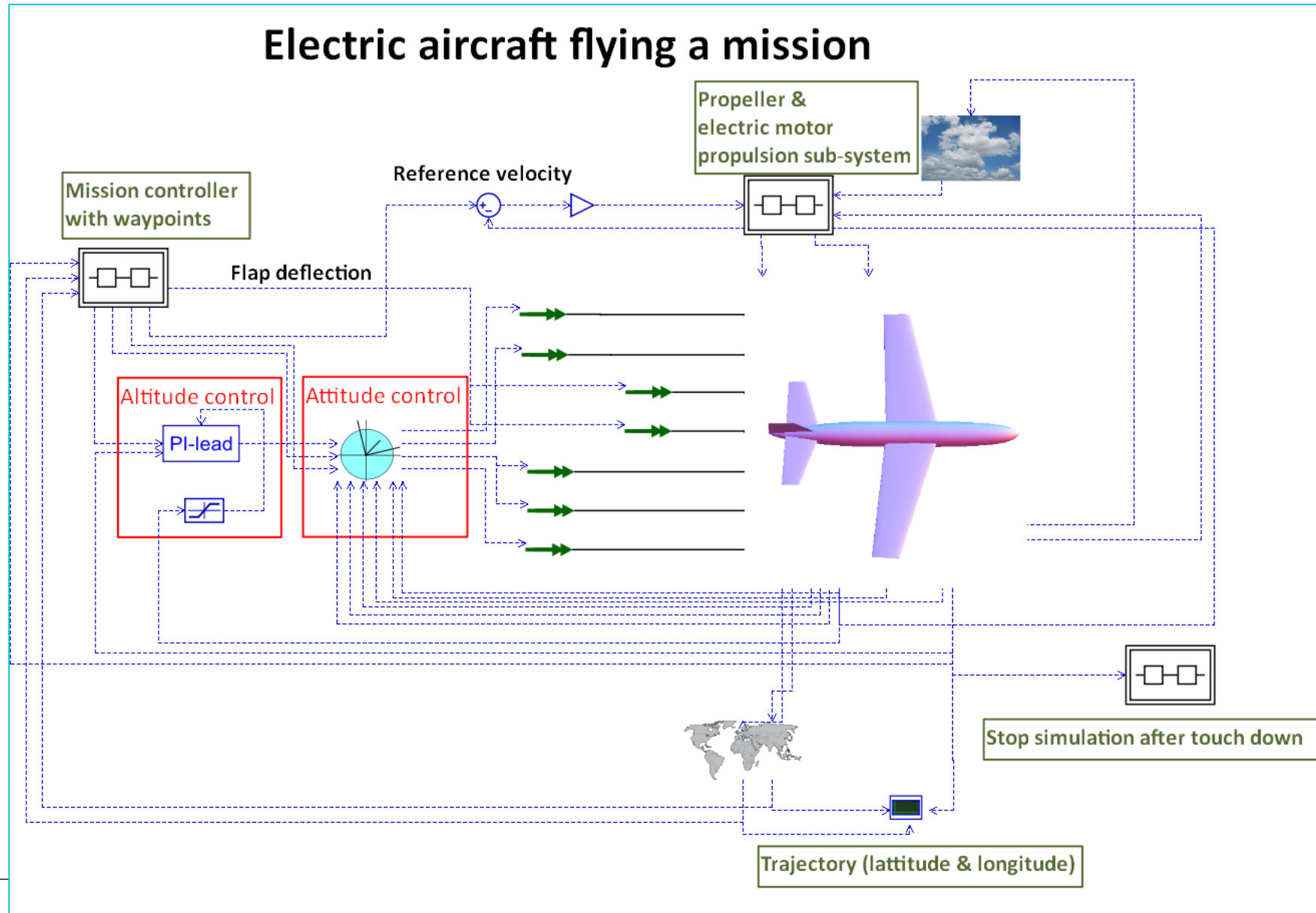
Objectives

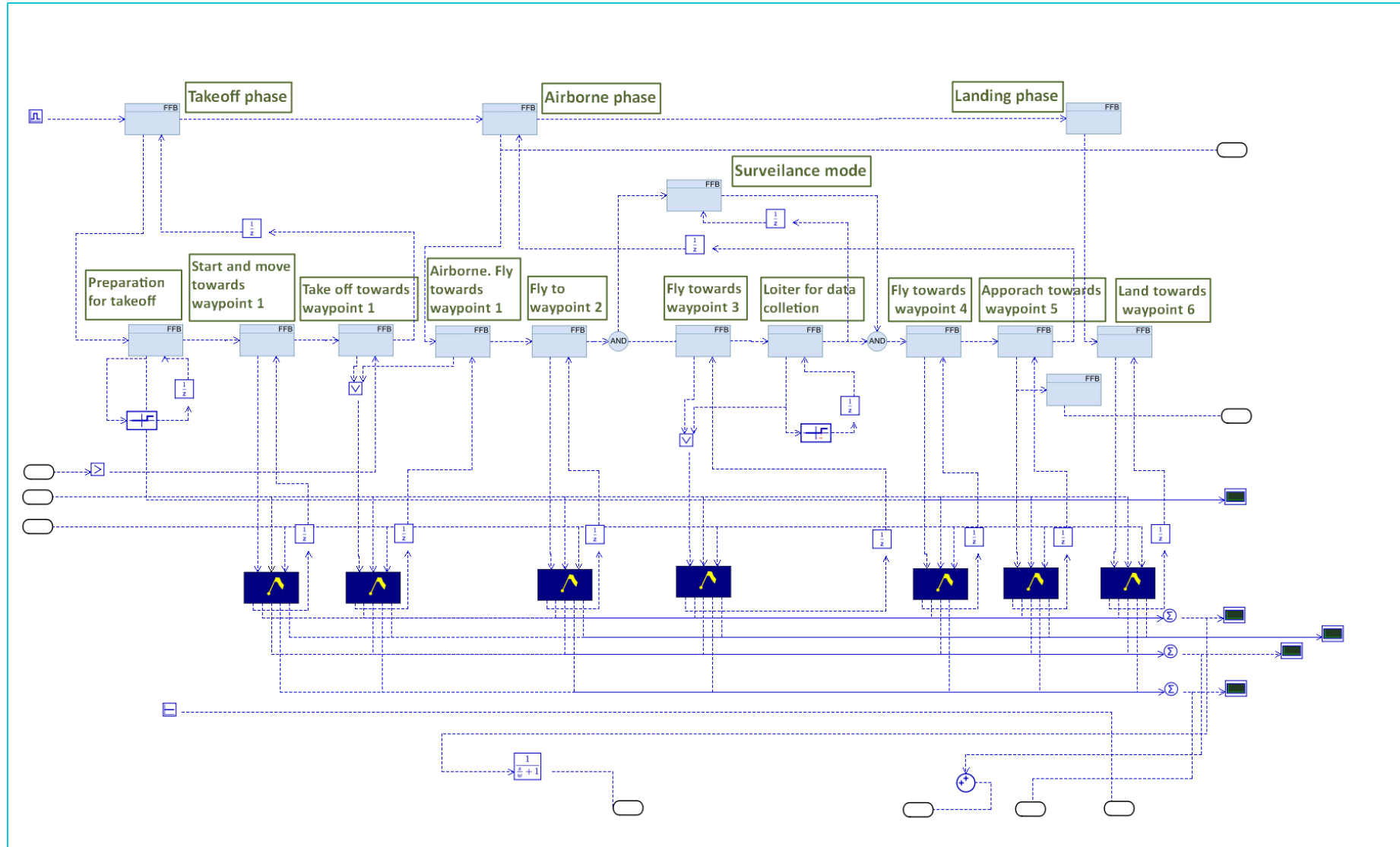
- Improve System of Systems (SoS) modelling and simulation.
 - Advanced Communication logs.
- Advanced decision-making loops.
 - Simpler? code.
 - Human-like decisions.
 - Human-like errors.
- Optimize aircraft designs and operational constraints.
 - How?

Methodology

- Design Research Methodology:
 - Gain knowledge and discuss the work and future options.
- Literature review:
 - Generative AI used in other fields, mainly to propose “solutions”.
 - Used previously to fully represent agents with very low fidelity but conversational capabilities.
 - ***Gemma3*** models (easy to run local)



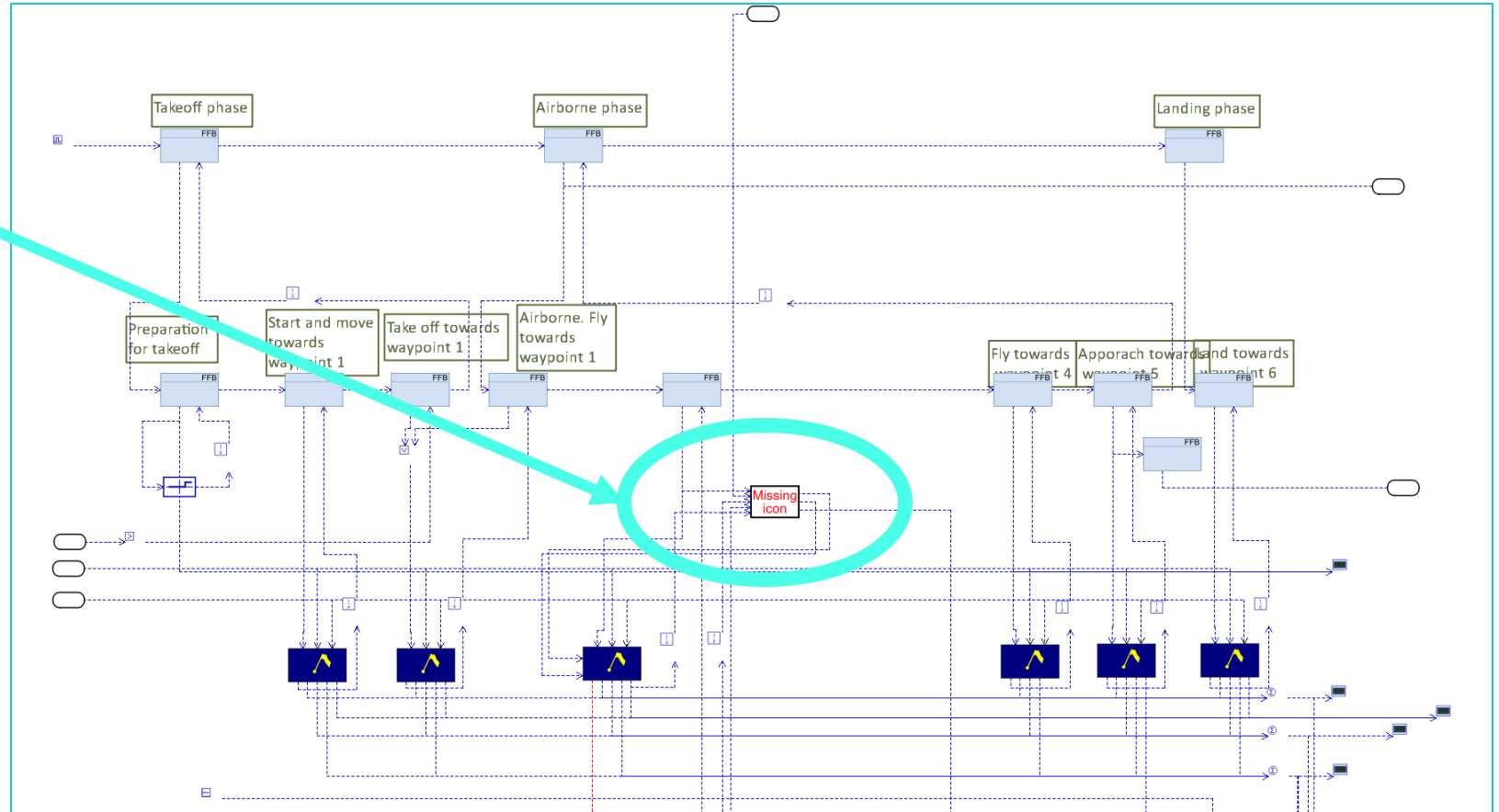




Trade of component logic with human logic

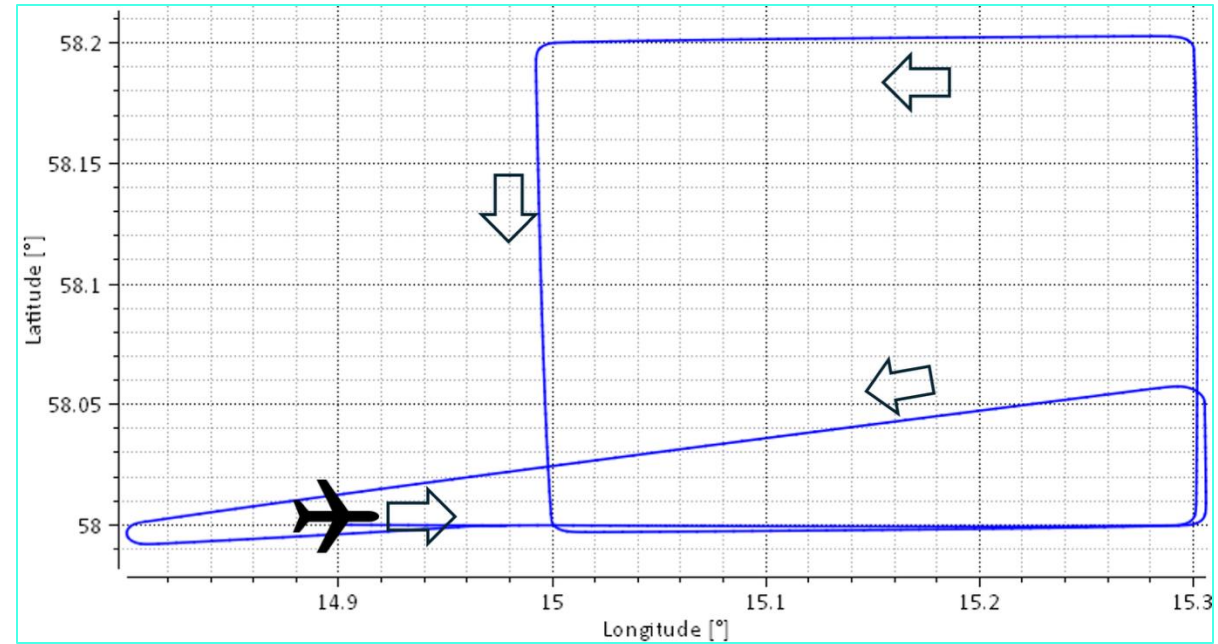
Numerous challenges:

- Consistent answers
- Correct format
- Performance

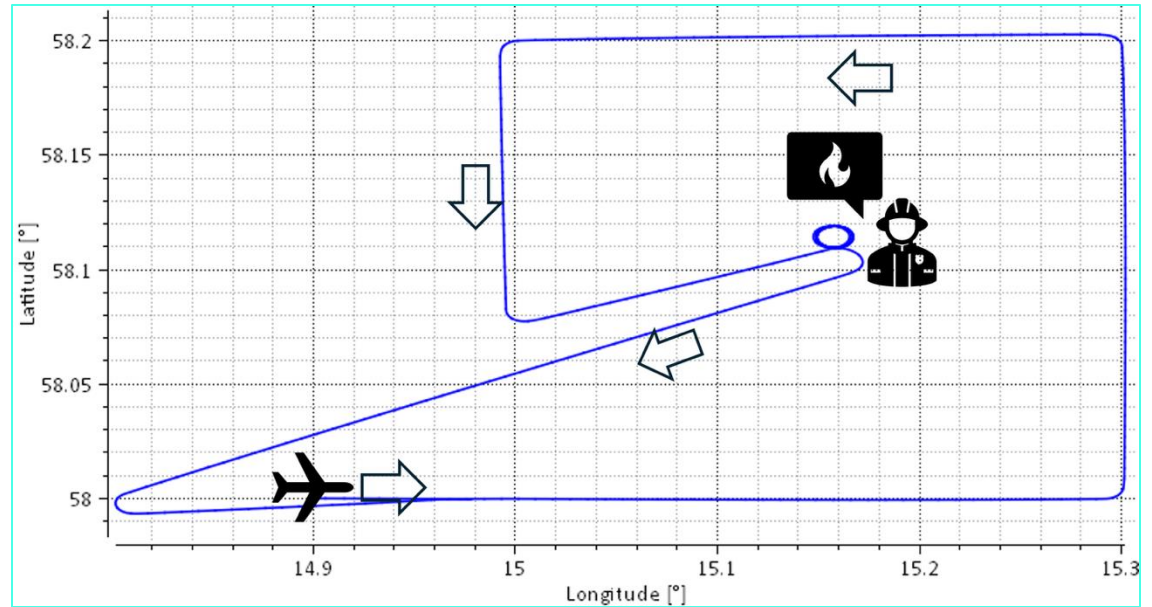
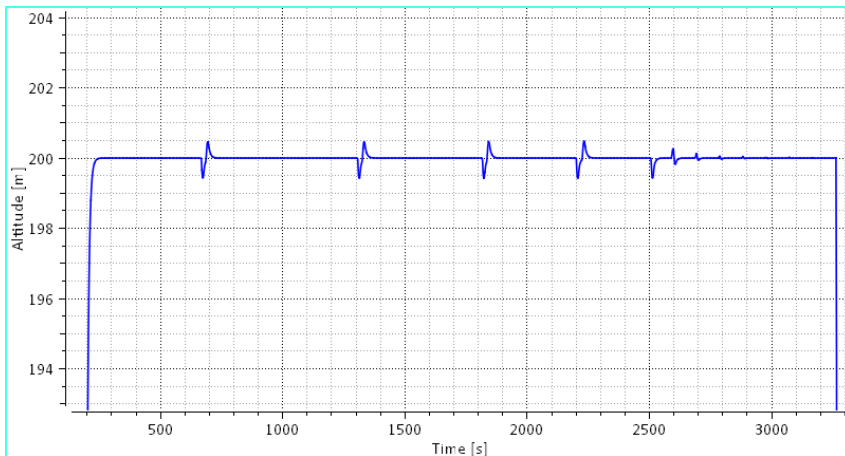
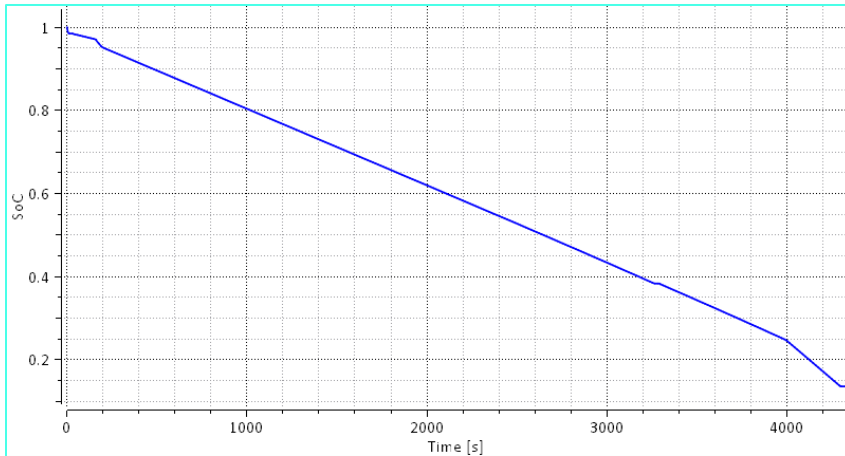


Results

Simple flight as base case using different waypoints

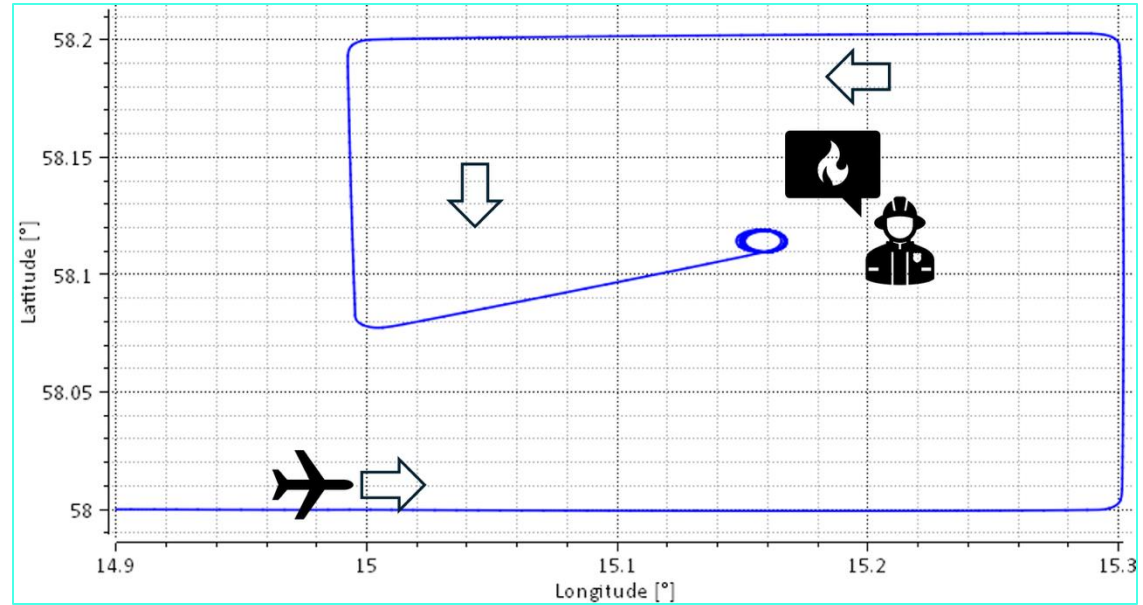
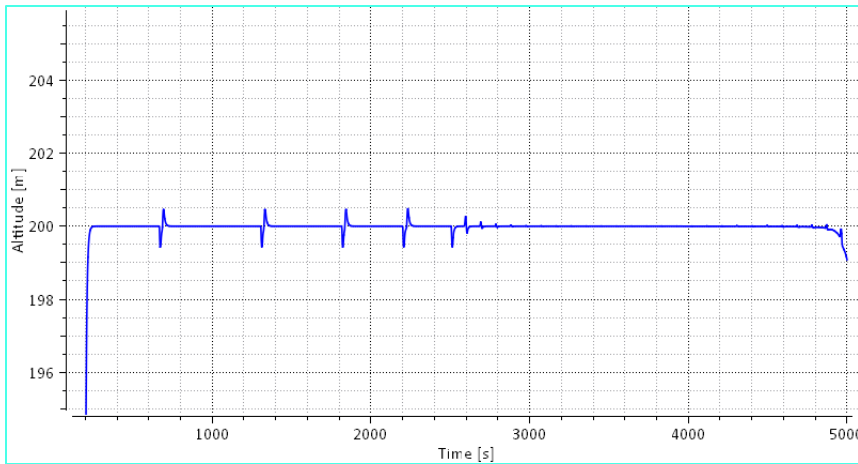
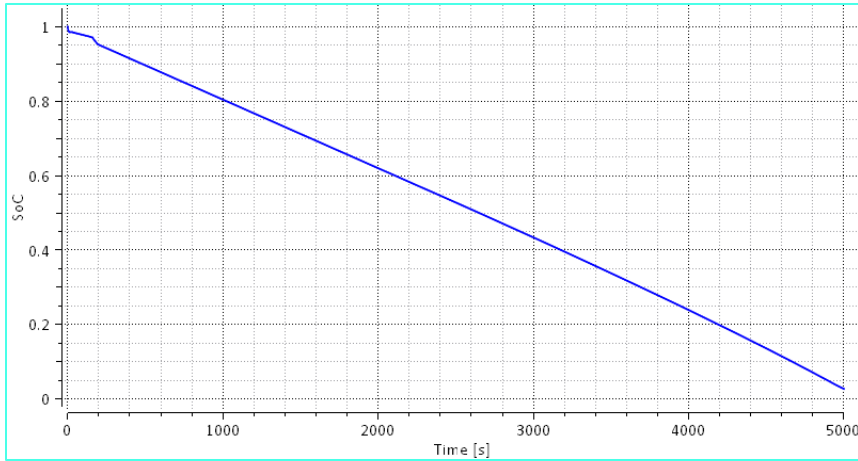


Results



No issues when using battery levels as a constrain

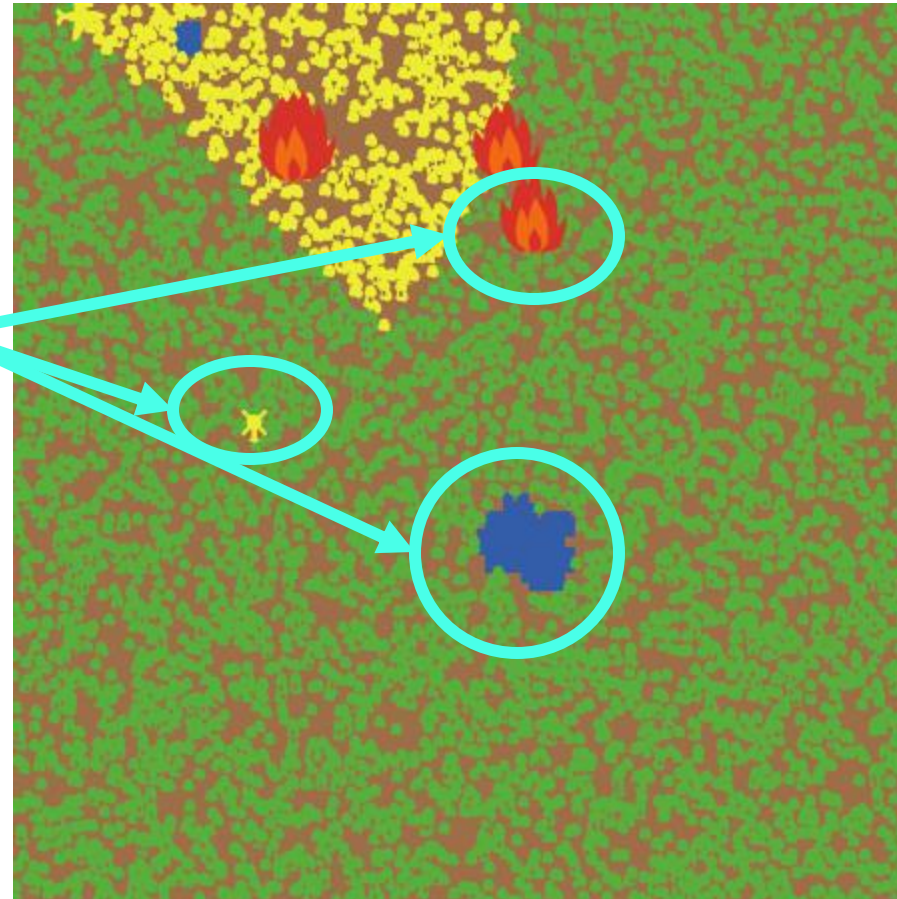
Results



Never to flew back!!

Results

Capable to identify relevant information from pictures and even the style of them.

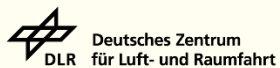


Discussion

- The technology is not ready for actual flight...
- But it adds value to modelling and simulation.
- It brings value during flight testing: evaluate events in language form.
- Smaller language models keep appearing, with enhanced image recognition, valuable as assistant.

Conclusion

- **Strengths**: provides natural language-based communication.
 - Operational analysis (communication issues).
 - Reduce radio “noise”.
- **Limitations**: prone to mistakes.
 - Hallucinations.
 - Inconsistencies.
 - Additional interface/interoperability.
 - Hidden initial prompts.
- **Future Work**: include it for image recognition and evaluation during flight, especially for model aircraft or UAVs or similar. Operational analysis with communication logs.



*COLLABORATIVE SYSTEM OF SYSTEMS
EXPLORATION OF AVIATION PRODUCTS,
SERVICES & BUSINESS MODELS*

Contact me: jorge.lovaco@liu.se



Thank You !

Scan me! 😊



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