UNIVERSITY OF MIAMI
COLLEGE of ENGINEERING

Machine Learning for the Dynamic Scheduling of Air Taxis

Assisting with the Rapidly Evolving New and Novel Uses of the NAS

Kelin Monahan and William Hoy Faculty Advisor: Dr. Nurcin Celik
University of Miami Department of Industrial and Systems Engineering

1. Meet the Team

Kelin Monahan

- Team Leader
- B.S. in Industrial and Systems Engineering

William Hoy

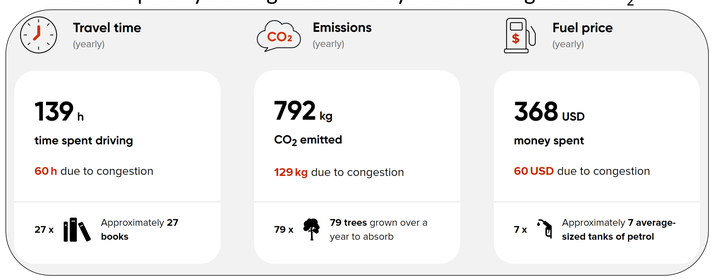
- Software Lead
- B.S. in Mechanical Engineering
- Pursuing a M.S. in Industrial and Systems Engineering

Dr. Nurcin Celik

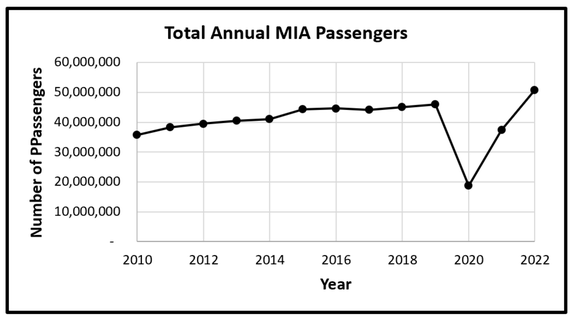
- Faculty Advisor
- Jones Career Development Associate Professor
- Industrial and Systems Engineering Director, Simulation and Optimization Research Laboratory

2. Problem Statement

Miami International Airport handles millions of passengers each year, and these passengers must get to and from the airport somehow. The current transportation infrastructure in Miami costs travelers almost 60 hours a year due to congestion, and that is not the only cost. While sitting in traffic, more fuel is burned consequently costing more money and emitting more CO_2.



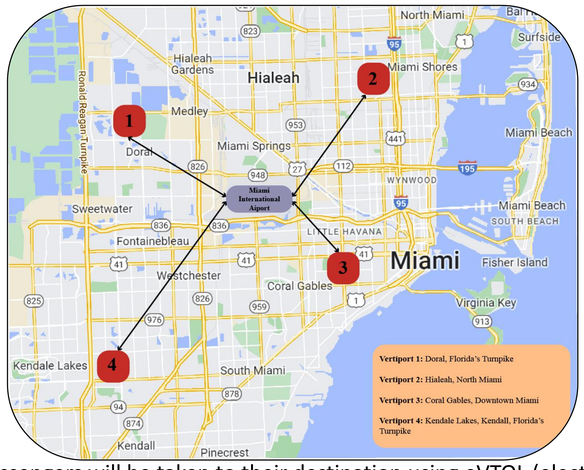
Miami International airport is the 10th largest airport in terms of Total Annual Passengers, reflecting its significant transportation activity.



The combination of the total passenger volume and car traffic congestion in Miami makes it an ideal spot to explore a new avenue of urban transportation.

3. Solution

Our proposed solution is **an autonomous air mobility system** that connects MIA to population hubs around Miami. These locations, known as vertiports, will act as a train station-like hub.



Passengers will be taken to their destination using eVTOL (electric Vertical Take-Off and Landing) aircraft. These aircraft have a limited range but are ideal for local travel.

. Photo Courtesy of Joby Aviation. (c) Joby Aero, Inc.

4. Methodology

1.Data Acquisition and Use

1. One week of flight data from Miami International Airport
2. Census population in cities surrounding airport
3. Traffic data in Miami

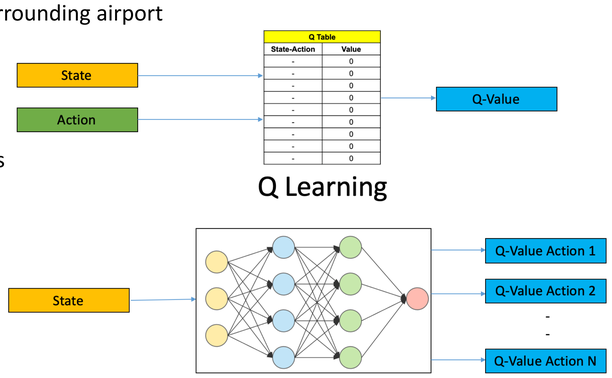
2.Deep Learning Approach

Reward System based on:

1. Meeting Demand Rate
2. The Number of Available Taxis
3. Passengers Total Travel Time
4. Total Passengers Served

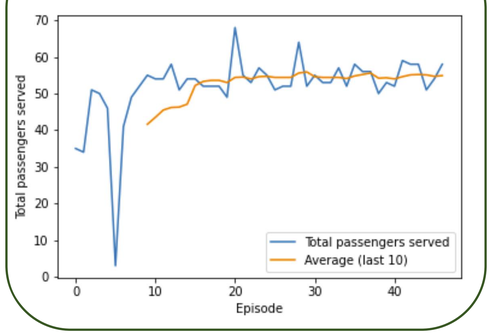
3.Challenges

1. Computing Power
2. Time Constraint
3. Gathering Data Originally
4. Market Specifics

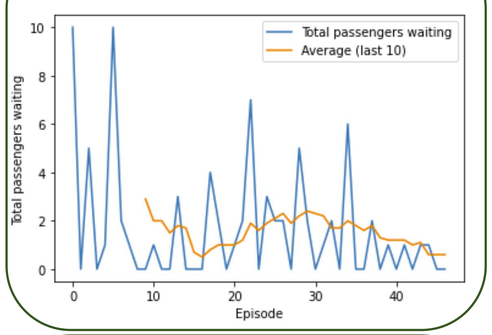


5. Results and Conclusion

Number of Passengers Served per Episode

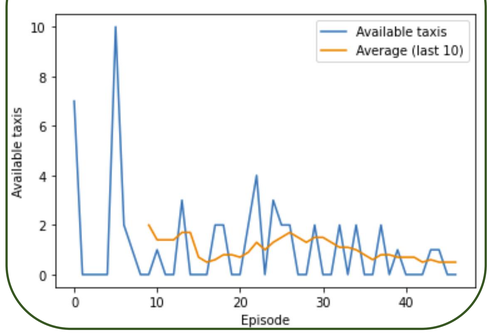


Passengers Waiting for Service per Episode



Lambda server run time ~8 hours and 47 episodes

Number of Available Taxis per Episode



Results

- The average trend line (orange) for each graph shows a positive result in the limited run time
- The graphs provide evidence that the agent was able to learn and optimize the dynamic scheduling service
- Multiple long runs are needed to provide further insights into the advanced consequences of the system

Future Outlook:

- Awarded a grant from the University of Miami's Institute of Data Science and Computing
  - This grant will be used longer runs, producing better outputs
- We will be building a more advanced model, incorporating a dynamic pricing model
- We will continue to reach out to industry leaders to learn more about this newly emerging field

7. Acknowledgments

We would like to acknowledge and express our gratitude to Dr. Nurcin Celik for her invaluable guidance as our faculty advisor. We also extend our thanks to Dr. Nina Miville for her valuable contributions. Additionally, we appreciate the support of the Program Team and the Steering Committee, especially Shannon Verstynen for her consistent and helpful communication.

8. References

Biba, J. (2023). *What Are eVTOLs? Are They the Future of Aviation?* Built In. https://builtin.com/transportation-tech/evtol-aircraft

Baheti, Pragati (2023). *The Beginner's Guide to Deep Reinforcement Learning*. https://www.v7labs.com/blog/deep-reinforcement-learning-guide

Google (2023). *Miami-Dade County.* https://www.google.com/maps

Sharma, S. (2020). *The Ultimate Beginner's Guide to Reinforcement Learning.* https://towardsdatascience.com/the-ultimate-beginners-guide-to-reinforcement-learning-588c071af1ec

Supernal Newsroom (2022). *Supernal and City of Miami Agree to Enable Development of Advanced Air Mobility.* https://newsroom.supernal.aero/supernal-and-city-of-miami-agree-to-enable-development-of-advanced-air-mobility-143ae88cf466

TomTom (2021). *Miami traffic.* https://www.tomtom.com/traffic-index/miami-traffic/