NASA MDAO Efforts in 2024

U. Michigan MDO Workshop

August 22-23

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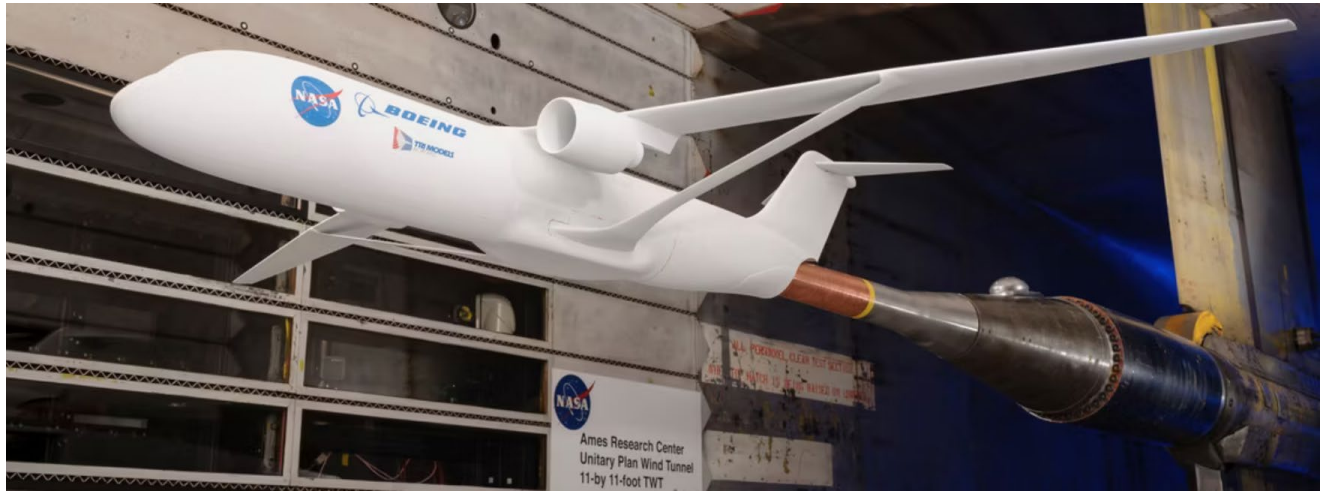
NASA Glenn Research Center

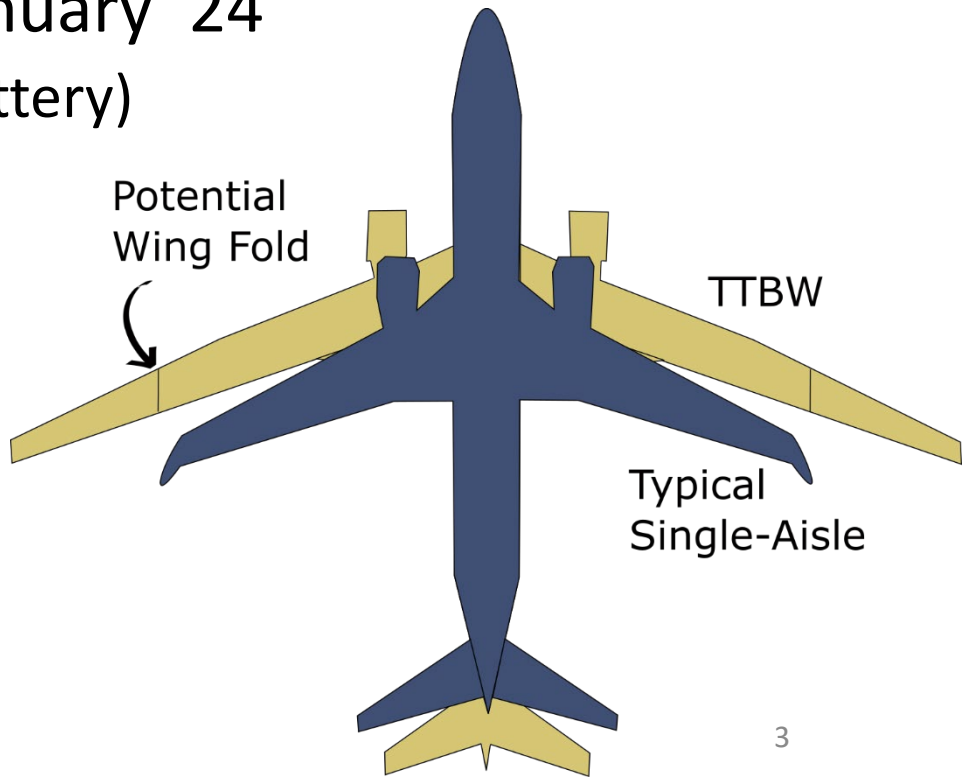
Overview

- Aviary preliminary aircraft design tool
- Subsystem Modelling
  - Motors and Gearboxes
  - Batteries
  - Cycle analysis
  - Acoustics
  - Uncertainty
- Internships
- Open Discussion

Aviary

- Open-Source Release December ’23
- General Aircraft Preliminary Design Tool built on OpenMDAO
- SciTech Paper with TTBW Demonstration January ’24
  - VSPAero, pyCycle, Electrical (motor, inverter, battery)



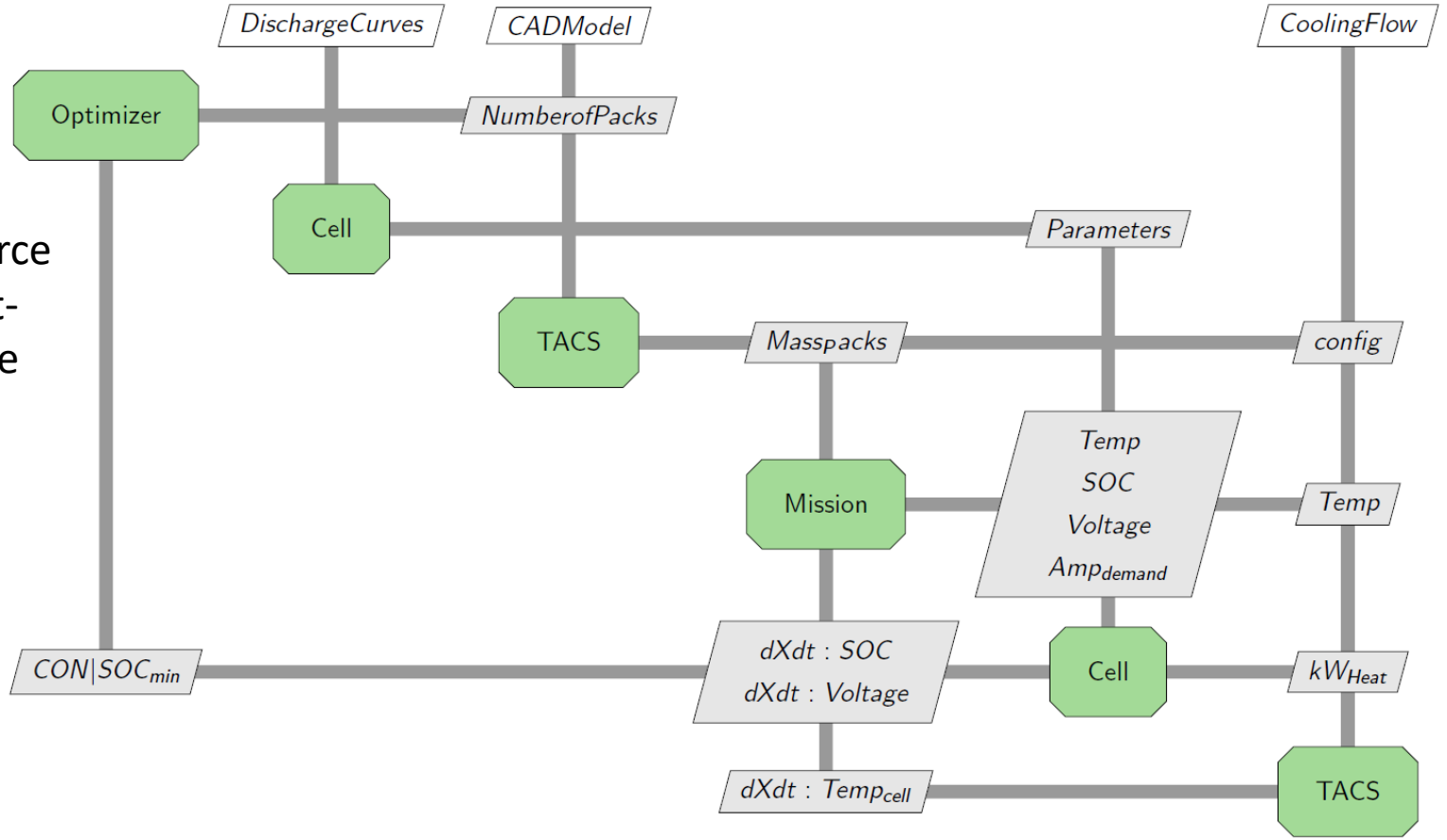


Motor and Gearbox Modelling

- Translation of discrete gearbox model from matlab to OpenMDAO
- Re-examination of 6-passenger Quadrotor electrical system and the integration of higher order electrical systems
  - Cable Models
  - Motor Models
  - Gearbox Models
- Demonstrating how subsystem designers can take advantage of Aviary: Advanced Motor Models
  - Swap out subsystem models in Aviary TTBW optimization

Battery

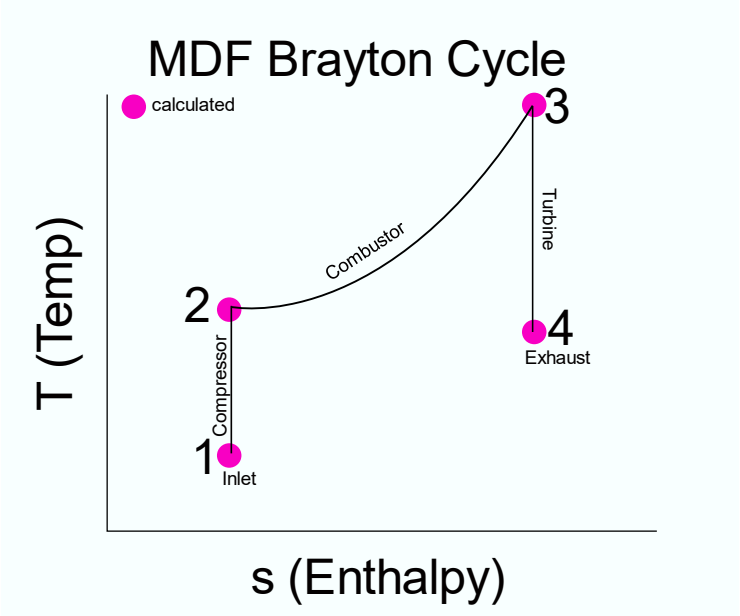
Goals: Combine cell modelling expertise from Ames with pack-modelling expertise and structural-thermal modeling capabilities at Glenn to produce an open-source battery model that is compliant with gradient-based optimization and can be used for future system-level studies of electrified aircraft.

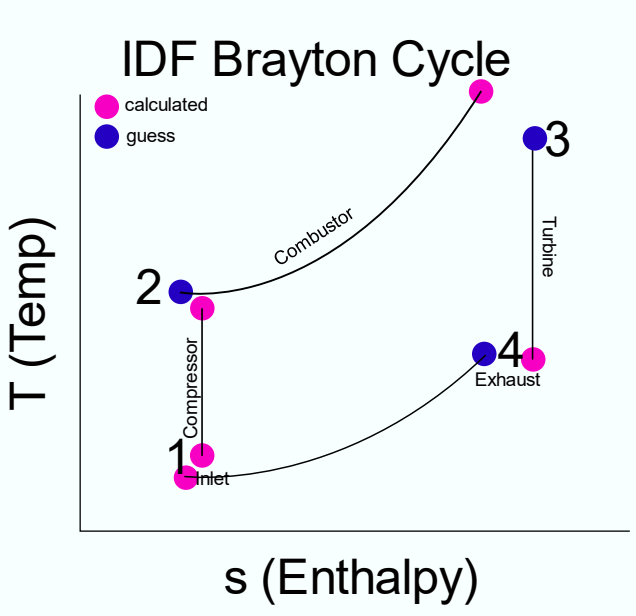


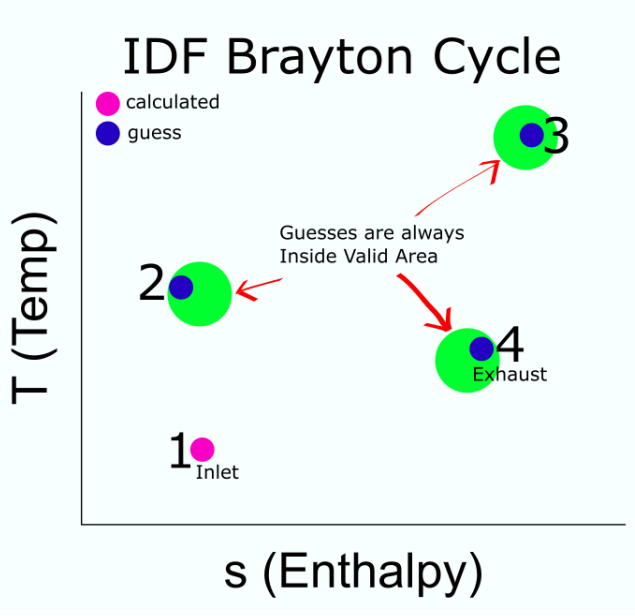
Cycle Analysis

- NPSS AD
  - Adding derivatives to NPSS using automatic differentiation, AI, and ML methods

- pyCycle IDF
  - Investigate increasing convergence / stability of cycle models using Individual Design Feasible Architecture





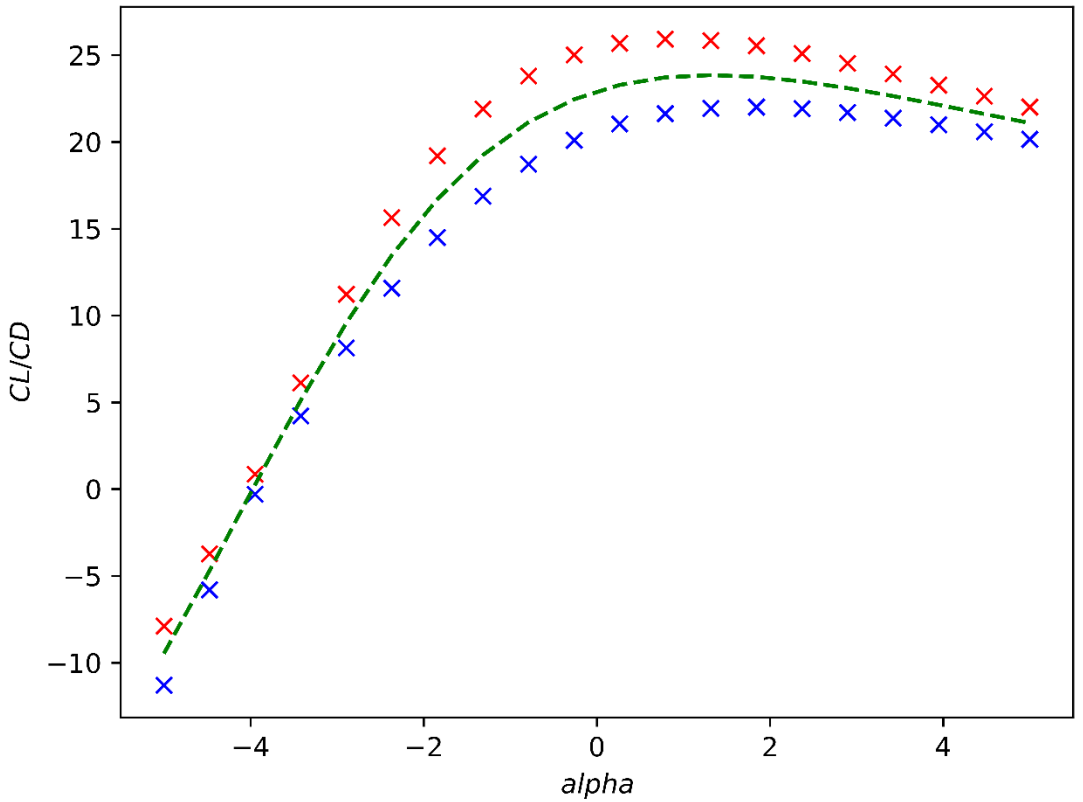


Acoustics

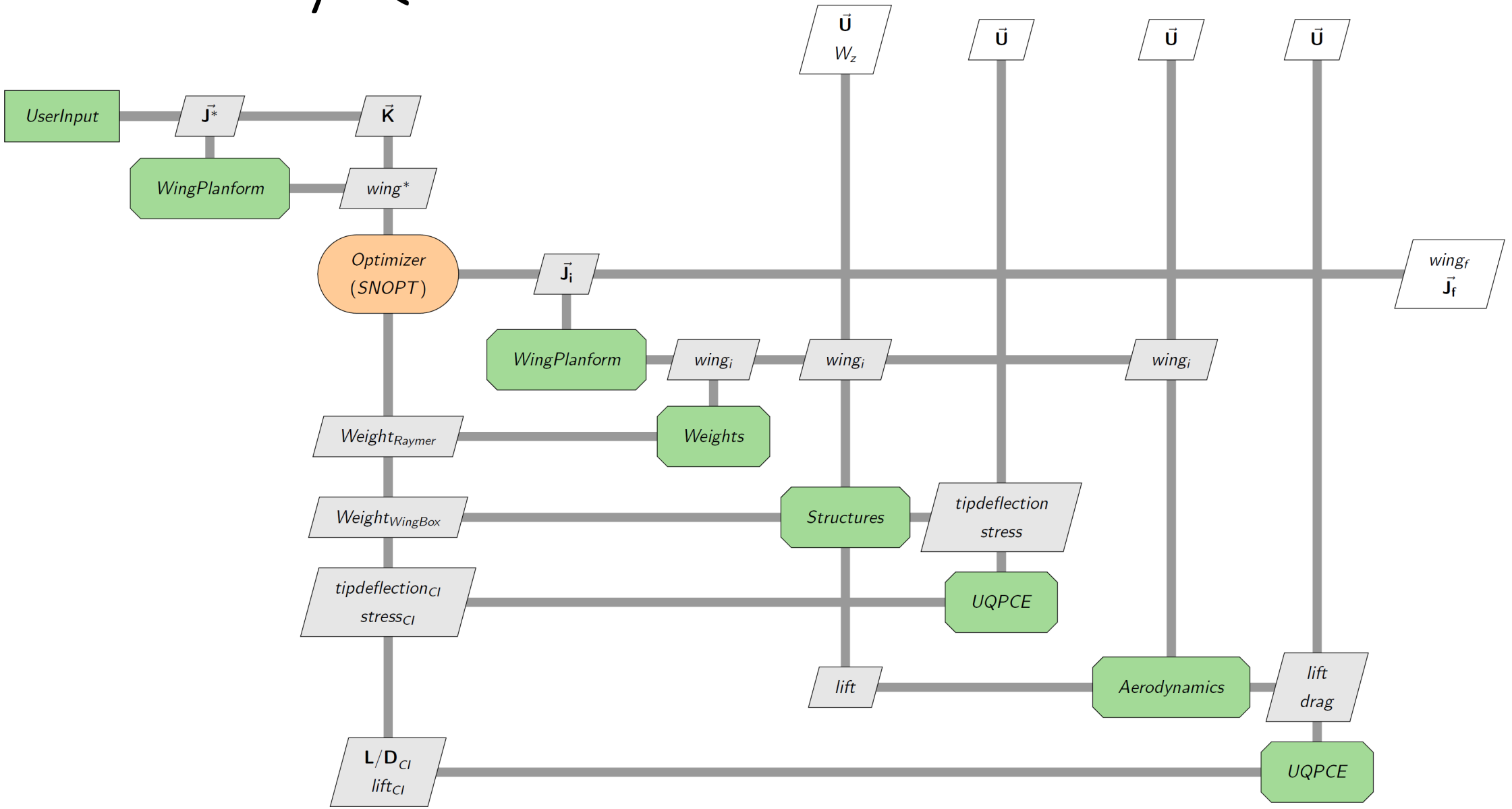
- AcousticAnalogies.jl
  - Open-Source Release with Tonal Noise – Completed
  - Useful for open-rotor noise calculations
  - Add Broadband Noise calculations – ‘24
  - Combine with CCBlade and create an Aviary example – 24’
- Acoustic Optimization of a Blade
  - Using VSPAero + Finite Difference
  - Wind-tunnel testing in ’24
  - Optimization not converging
    - Code Coverage on different Execution Paths
    - Automatic Derivatives producing Incorrect Results

Uncertainty Quantification

- Helps researchers understand how much “Better” models are
- “End-to-End Uncertainty Quantification with Analytical Derivatives for Design Under Uncertainty“ – Phillips et. al. SciTech ‘24



Uncertainty Quantification



Internships – Summer 2024

- Modelling novel and traditional aircraft and aircraft subsystems, testing features, and contributing to Aviary software development. Aviary is a new aircraft design framework that will be released to the public in December 2023. Idea candidates will have familiarity with aircraft design challenges through classwork or hands-on work. Familiarity with python is strongly preferred. Candidates should have completed their Junior year of undergraduate study by June 2024.
- Apply By August 31st

Open Discussion

- OpenMDAO
- Dymos
- Aviary
- Subsystem Models
- Internships