MULTIDISCIPLINARY DESIGN PROGRAM

# Collins Aerospace Galley Thermal & Power Optimization


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# The Big Picture

- Problem:
  - Galleys represent the largest electrical load on an aircraft, releasing substantial waste heat
  - These inefficiencies result in excess fuel consumption
  - Airlines are concerned with cost, reliability, and emissions reduction
- Solution Impact:
  - Collins can deliver a more efficient galley system to customers
  - Airlines can save on fuel costs and reduce their footprint
  - Can help industry shift to More Electric Aircraft
    - Replacing hydraulic/pneumatic systems to electrical ones
    - Will mitigate anticipated increase in power demand

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# A Galley and its Inserts


A350's main galley with Collins Aerospace inserts (The Points Guy, 2017)

Essence debuted in 2014 (Collins Aerospace, 2014)

# Project Objectives

- **Goal:** Reduce the power consumption of the aircraft galley system
- Critical Requirements:
    - The solution(s) shall reduce the average power consumption by at least 10%
    - The solution(s) shall reduce the peak power consumption by at least 25%
- How do we validate the performance of our solution(s)?
    - No access to a physical galley
    - Further difficulties with COVID-19 restrictions

# Project Tasks

1. Research and collect information on galleys
    1. Typical insert (device) usage
    2. Understand the thermal and electrical characteristics of each insert
2. Build a model that mimics an existing Airbus A350 galley's power consumption over a typical flight
3. Develop solution concepts to reduce the power consumption
4. Integrate solutions into the model to validate their performance

# Power Consumption Model

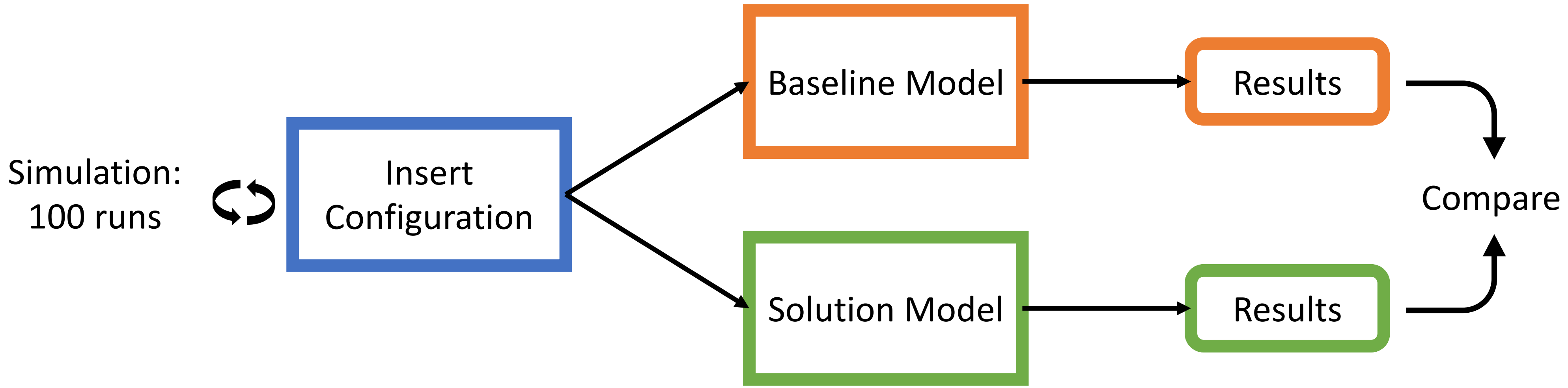
- Simulates a “typical” 8-hour flight in MATLAB
  - o Probability distributions create unique parameters governing passenger needs for a specific flight (Monte Carlo approach)
  - o Uniqueness between simulations
- Incorporates realistic thermal models of each insert
  - Thermal behavior of each insert
  - Thermal interactions between inserts in proximity
- Designed for easy solution integration
  - Adaptable to new or modified solutions
- Tracks associated power consumption of each insert

# Solution Concepts

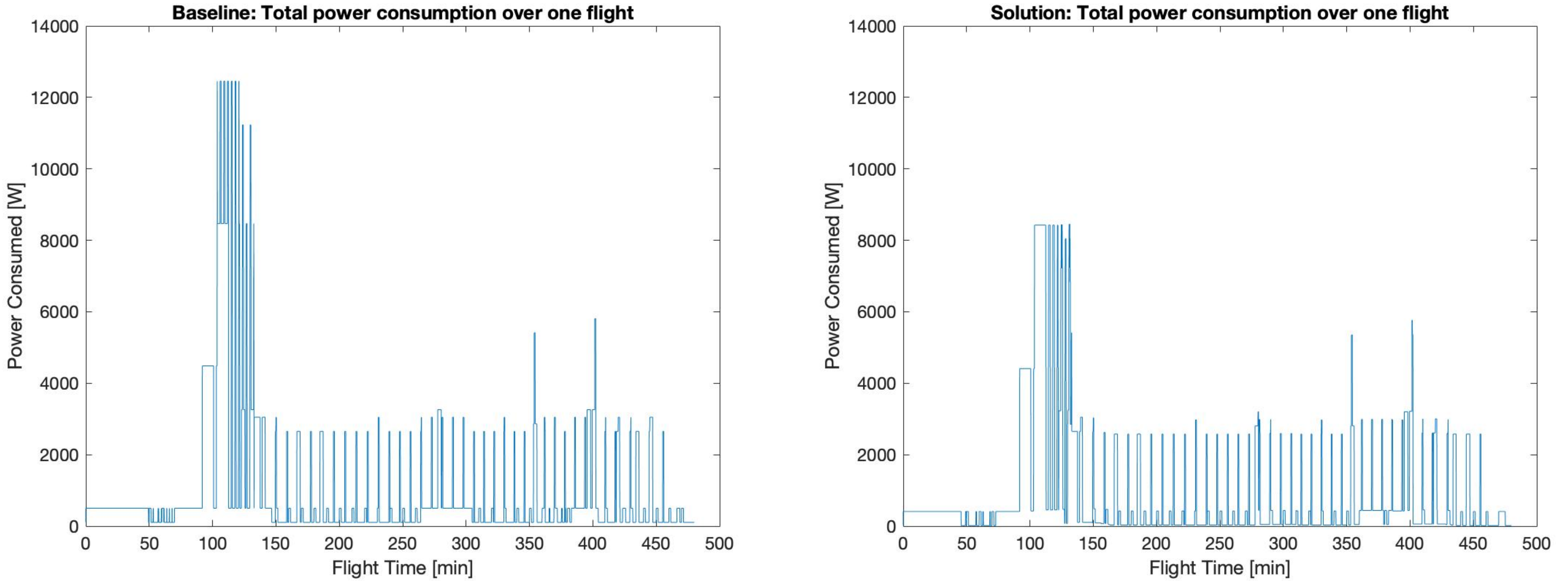
- Improved aerogel insulation for chilled cart bays
  - Reduces heat loss through the cart bay walls
  - Lighter than existing insulation
- Variable cart bay airflow
  - Only provides cooled air to occupied cart bays
  - Current system provides air even when carts are removed
- Power management controller
  - Sorts power requests based on priority, distributes power to a subset of the inserts to avoid violating maximum threshold
  - Shuts down inserts that remain in standby for extended periods of time
  - Current system doesn't monitor power demands

# Performance Validation

- Validation script runs 100 simulations of the baseline and solution galley architectures
- Same randomized configuration used for both architectures in each simulation



# Results




**Goal**: Reduce average power consumption by 10% and peak power by 25%

**Achieved**: Reduced average power consumption by 12.8% and peak power by 27.4%

# Implications & Next Steps

- Model is a tool for Collins Aerospace to employ
  - Further development of our solution concepts
  - Rapidly test new concepts
- Less power consumption results in fuel savings
  - Lower power peaks can lead to smaller generators and further savings
  - Reduction in emissions and cheaper air travel
- More energy available other on-board systems
  - Industry shift to More Electric Aircraft

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## Thank You For Listening!