



# Carleton University Blended Wing Body Gas Turbine Engine (CUB-GT)

## Mechanical & Aerospace Engineering 4<sup>th</sup> Year Project 2025/26



### Blended Wing Body (BWB) Aircraft and Propulsion

- Blended Wing Body aircraft integrate the fuselage and wings into one smooth lifting surface with no clear separation between them
- Potential ~50% reduction in fuel burn and carbon emissions compared to current aircraft
- Flight Test Vehicles (FTV) are subscale aircraft used when ground testing cannot provide sufficient data.
- Typical FTV engines are small turbojet gas turbines – thrust ranges from 50–500 lb (200–2000 N)



Airbus BWB Maveric prototype [Wired, February 2020]



JetZero Z4 Midmarket Model Concept [AWIN, December 2024]

#### FTV Testing Goals

- Understand complex flight control behavior
- Develop flight control laws for unconventional aircraft
- Collect aerodynamic and flight performance data

### CUB-GT GOAL

- Design an efficient, very small gas turbine engine
- More efficient than a JetCat P500
- Push feasibility of small gas turbine engine in commercial industry

Join CUB-GT and gain practical skills and experience in this mechanical and aerospace engineering project!

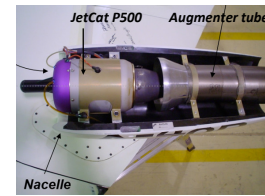
### FTV Propulsion

#### Typical FTV Engine Features

- Single-stage centrifugal compressor
- Single-stage axial turbine
- High fuel consumption & noise
- Limited flight endurance

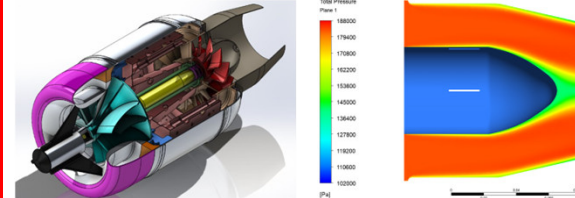
#### Design Opportunities

- Develop more efficient small gas turbines for FTV
- Remotely piloted unmanned aerial vehicles (UAVs)



JetCat P200 turbojet engine in Boeing X-48B BWB [Cosentino, SAE AeroTech Congress and Exhibition, 2009]

#### 2024/25 Past Work – Reverse Engineering of JetCat P500



Model of JetCat P500

### Project Inspiration

During the Boeing X-48B project, researchers from NASA and Boeing investigated small turbofan concepts.

#### Experimental Design

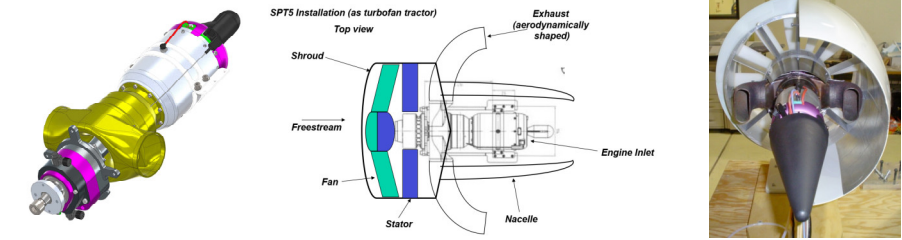
- Modified an available JetCat SPT5 turboshaft engine to a turbofan configuration
- Replaced the propeller drive with a fan
- Converted it into a very small turbofan
- Turbofan engines, where airflow bypasses the engine core (compressor, combustor, turbine, and propelling nozzle) were developed to increase the propulsive efficiency and reduce engine noise

#### Results

- Improved fuel consumption compared to the JetCat P200
- Higher fuel consumption than the original turboshaft
- Lower thrust than the propeller configuration

#### Key Outcome

Demonstrated the feasibility of developing small turbofan engines



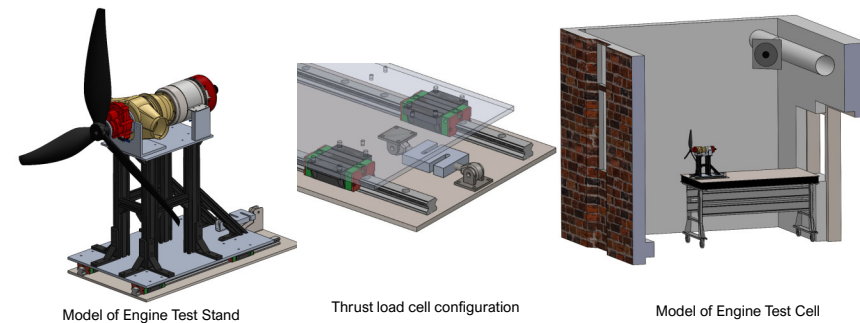
From left to right: JetCat SPT5 turboshaft engine [JetCat]; re-design of SPT5 as turbofan; nearly fully assembled SPT5 turbofan [Cosentino, SAE AeroTech Congress and Exhibition, 2009]

### Turboprop Configuration ← KingTech Turboshaft Base → Ducted Fan Configuration

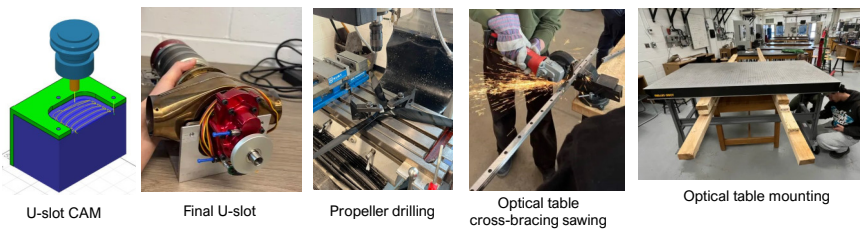
### CLEAN SHEET DESIGN – 500 N Turbo Fan

#### Phase 1A: Modelling of turboprop – KingTech engine's conventional configuration

#### Phase 2: Test stand design and manufacturing



#### Phase 3: Turboprop test stand manufacturing

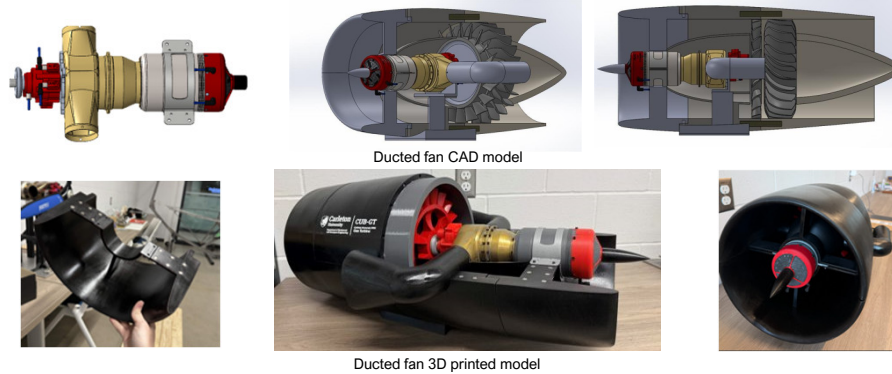


#### Phase 4: Turboprop assembly with test rig

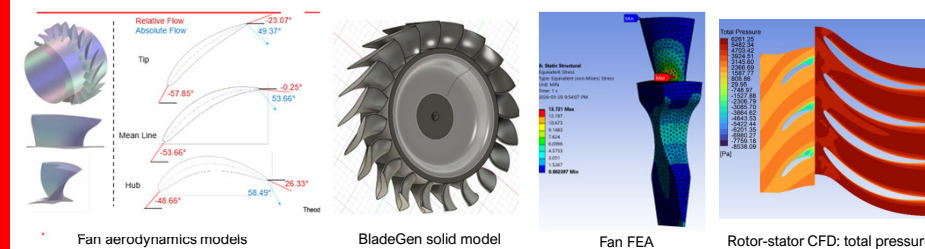


#### Phase 5: Performance testing – 2026/27

#### Phase 1A: Modelling of ducted fan



#### Phase 1B: Thermodynamic, aerodynamic and mechanical design



#### Phase 2: Ducted fan component sourcing and manufacturing – 2026/27

#### Phase 3: Test stand design and manufacturing – 2026/27

#### Phase 4: Performance testing – 2026/27

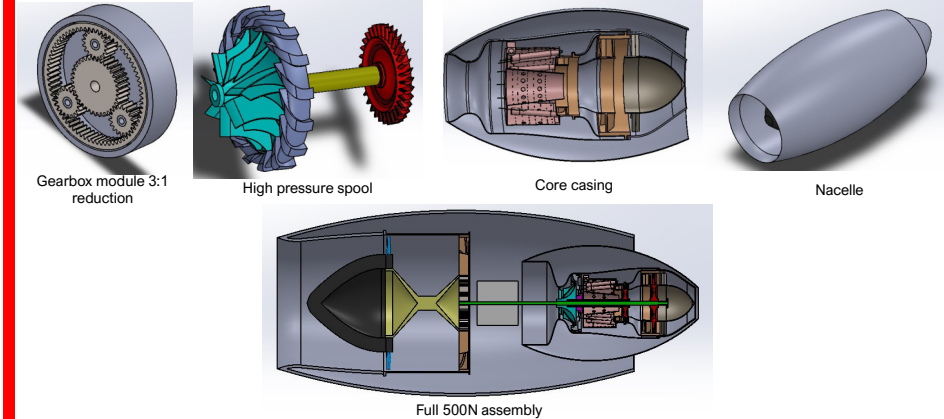
### FUTURE PLANS 2026/27 and BEYOND

#### Future plans for the CUB-GT project include:

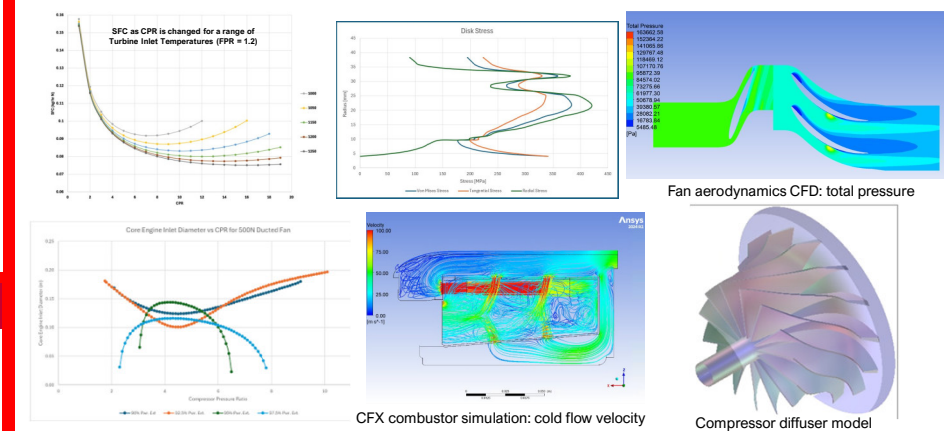
- Turboprop performance testing – data collection and analysis
  - Ducted fan component selection and manufacturing
- Ducted fan performance testing – data collection and analysis
  - Next iteration of 500 N turbo fan design

#### No use of preexisting engine. Full design from the ground up!

#### Phase 1A: Modelling of turbo fan



#### Phase 1B: Thermodynamic, aerodynamic and mechanical design – next iteration in 2026/27



#### Phase 2: 500 N turbo fan component sourcing and manufacturing – 2027/28

#### Phase 3: Test stand design and manufacturing – 2027/28

#### Phase 4: Performance Testing – 2027/28