

# Machine Learning for Cryogenic Composite Hydrogen Tank Design and Optimization for Sustainable Aviation

Master's or/and PhD thesis Projects

## Objective:

The optimization of cryogenic composite hydrogen storage tanks is a critical enabler to achieving carbon-zero aviation. These tanks must deliver high structural performance while minimizing weight to meet the stringent requirements of onboard hydrogen storage systems.

This research project aims to develop and apply **Machine Learning (ML) methodologies** for the **engineering design and optimization** of cryogenic composite hydrogen tanks. The project will integrate data-driven and physics-informed ML methods with high-fidelity simulations and experimental data to accelerate design cycles and enhance the accuracy and fidelity of ML-based engineering design tools.

## Proposed research may include the following:

The scope of work will be tailored to ensure successful thesis completion (Master's or PhD level)

- Conduct a comprehensive literature review on machine learning techniques relevant to engineering design, with a specific focus on physics-informed machine learning approaches;
- Cryogenic composite tank conceptual design;
- Generate training datasets using experimental data and leveraging existing finite element simulations (2D/3D, section- or full-scale models) to capture tank performance under various service conditions;
- Develop and implement ML algorithms for structural performance prediction and optimization;
- Integration of composite manufacturing parameters into modelling to improve performance prediction accuracy;
- Validate and verify the developed ML models using experimental and simulation benchmarks;
- Support Prototype development of a full-scale cryogenic composite storage tank for manufacturing

## Required Skills & Knowledge

- Strong motivation and interest in finite element analysis, machine learning, and computational modelling;
- Proficiency in Python or other programming languages commonly used for ML and data analysis;
- Excellent mathematics, analytical, data processing, and problem-solving skills;
- Strong organizational and communication skills;
- Background in **Mech&Aerospace, Computer Science, Applied Mathematics**, or related fields;

- Ability to work both independently and as part of a multidisciplinary team;
- The student may be based at Carleton University or at the National Research Council Canada (NRC) campus on Montreal Road, Ottawa.
- Students may register through a Carleton University department outside of engineering, depending on academic background and interest.

#### **Language Requirement:**

- English

#### **Status:**

- Master student: Must be a Canadian citizen or Permanent resident
- PhD student: No citizenship requirement

#### **Start Date:**

- Master's program: September 2026
- PhD Program: Potential start in 2026 or 2027

#### **Applications:**

Interested applicants should send their resume and transcript to:

- [Lucy.Li@nrc-cnrc.gc.ca](mailto:Lucy.Li@nrc-cnrc.gc.ca)
- [JeremyLaliberte@cunet.carleton.ca](mailto:JeremyLaliberte@cunet.carleton.ca)