H2Crash: Crashworthiness of hydrogen-powered aircraft

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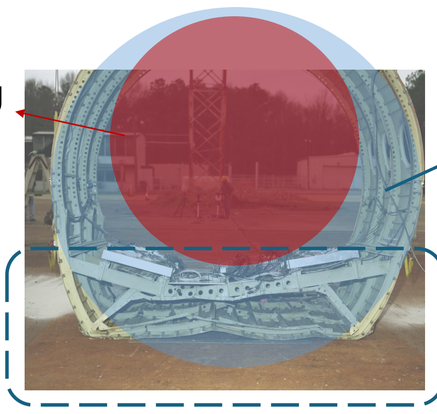
BACKGROUND



How to design the structure to **maximize H2 storage considering crashworthiness**?

HOW?

Topology optimization
New subfloor concepts will be translated to engineering designs.

Fuselage section generator
Parametric models will be developed to easily generate new analysis files.

Bayesian optimization
Surrogate models will be used for detailed sizing and optimization.

Validation case
A small-case structure will be prepared and tested in TU Delft's DASML.

H2Crash WP2: Damage tolerance inclusion
The results from Leith Afilal's WP will be added to the developed framework.

OBJECTIVE(S)

Optimizing the fuselage structure surrounding the hydrogen tank with competing objectives and constraints:

- Maximizing the kinetic energy dissipated
- Imposing a maximum crushing distance
- Minimizing weight

WHY?

- **Storage volume requirements**: LH2 needs four times the volume of kerosene for the same energy.
- **Impact on fuselage design:** Hydrogen storage must account for crashworthiness. Protective structures around the tank add weight and reduce the effective storage available for the tank.
- **Increased fuselage dimensions:** To maintain the same payload as conventional aircraft, a longer and bulkier fuselage is required, which increases the parasite drag, lowering fuel efficiency.
- **Regulatory uncertainty:** EASA CS 25 currently lacks specific guidance for hydrogen tanks, creating ambiguity in design requirements.
- **Competing objectives:** Balancing tank volume, crash safety, and structural integrity adds complexity to optimization.
- **Computational challenges:** Intensive crash simulations generate massive data, and large datasets are required for optimization.

RESULTS

The aim of the project is the development of design tools and methodologies that integrate hydrogen storage into aircraft while ensuring compliance with crashworthiness standards, to be used during preliminary design.

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