Active load alleviation

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BACKGROUND

Aircraft structures are subjected to varying aerodynamic forces during flight, including gust encounters and manoeuvres, which induce significant loads on the airframe. Active load alleviation methods offer a promising solution for improving aircraft performance by measuring aircraft responses and adjusting the load distribution using control surfaces to reduce the peak loads.

As a result, a lighter structure can be designed which leads to weight savings and reduced fuel consumption. Additionally, decreased loading on the structure results in less structural fatigue, prolonged lifespan, improved handling qualities and passenger comfort by actively damping unwanted vibrations from the flexible structure.

HOW?

1. Conduct literature study into active load alleviation
2. Construct an aeroservoelastic model of the Cessna Citation II
   a. Flight dynamics and loads
   b. Investigate methods for efficient model creation and reduced order modelling
3. Synthesize load alleviation controllers
4. Evaluate control law impact
   a. Change in peak loads and distribution
5. Modify Cessna Citation II model based on findings
   a. Lighter structure, increased aspect ratio, additional control surfaces
6. Retune the control laws and reevaluate the impact

OBJECTIVE(S)

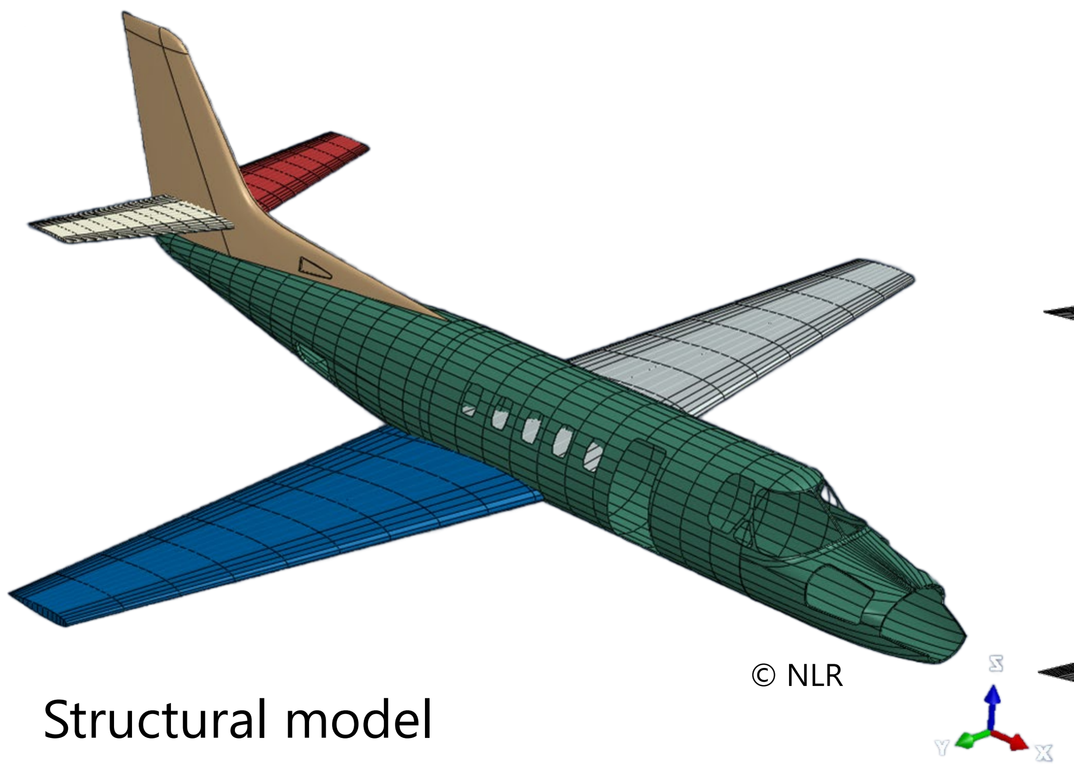
- Review the state of the art of active load alleviation
  - Manoeuvre and gust alleviation
- Investigate aeroelastic modelling suitable for control law synthesis
  - High and low fidelity methods
- Implement load alleviation control laws
- Evaluate the impact of active load alleviation control laws on aircraft
  - Load reduction, lifespan, increased actuator usage

WHY?

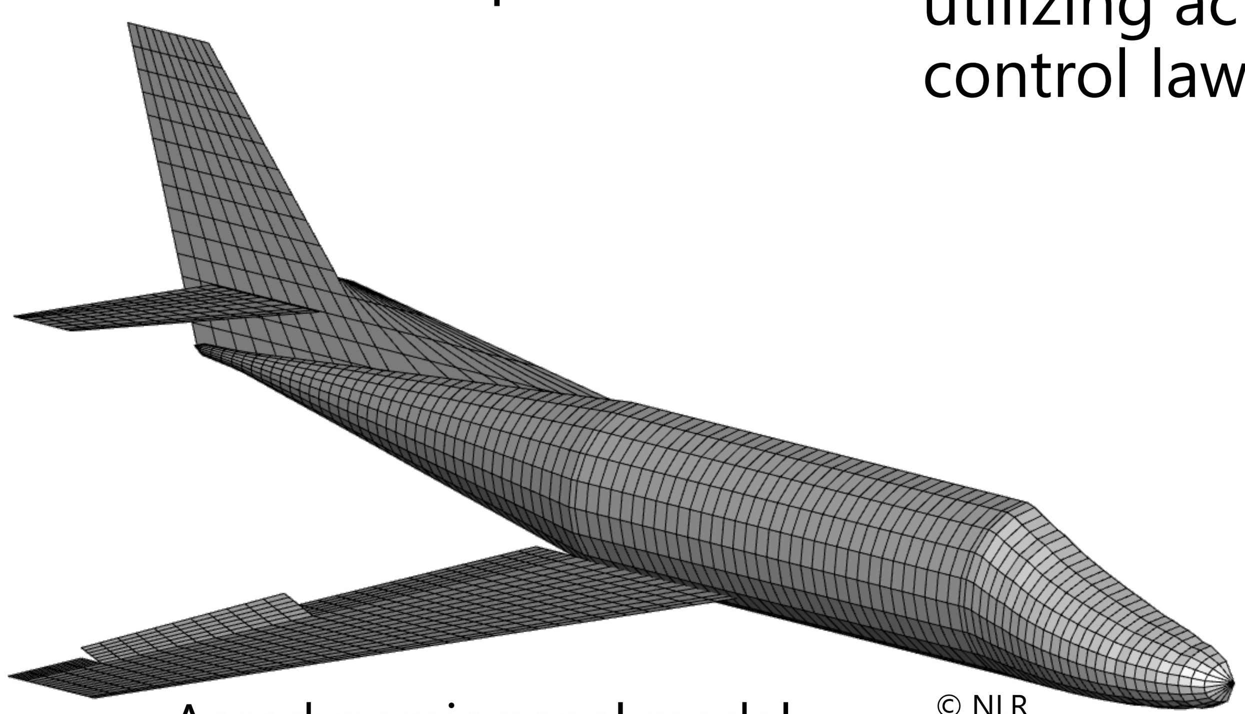
- Active load alleviation control laws can reduce the peak loads experienced by the aircraft structure and therefore lead to lighter and more efficient designs with improved fuel efficiency
- Understand the performance capabilities and challenges of active load alleviation

RESULTS

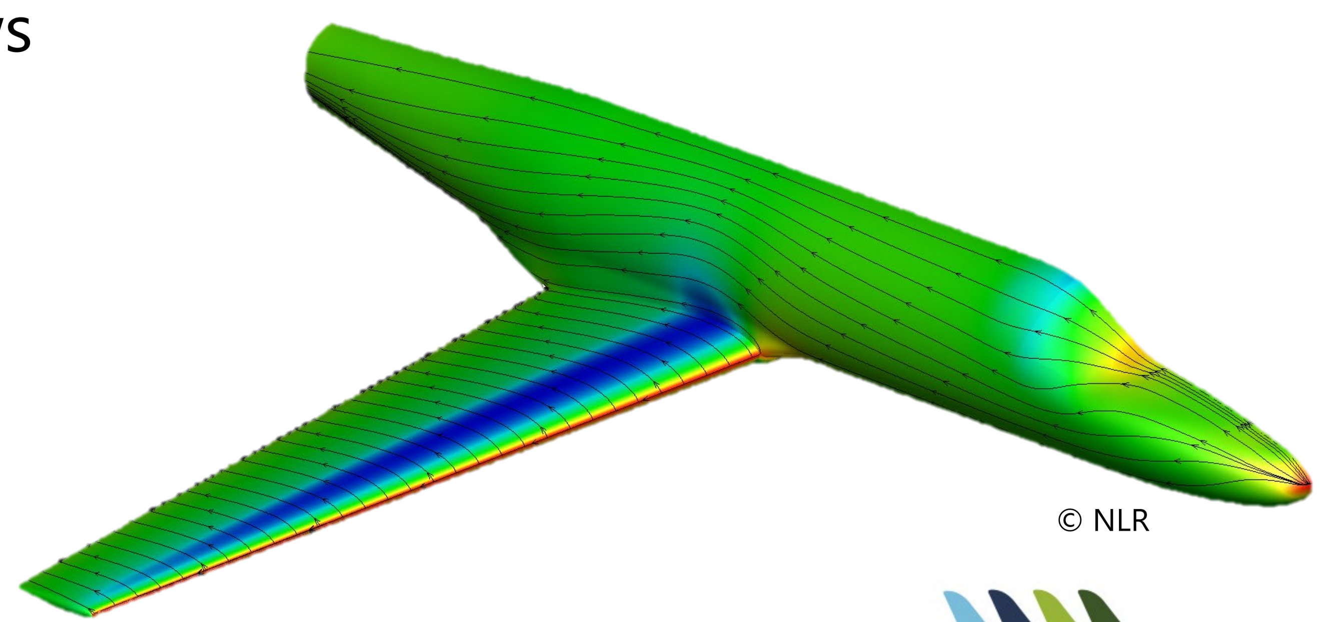
- Literature review conducted
- Structural and aerodynamic models implemented
- Expected: A modified Cessna Citation II concept utilizing active gust and manoeuvre load alleviation control laws



Structural model



Aerodynamic panel model



CFD model

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