

EIN MODELL FÜR TRIEBWERKSVIBRATIONEN ZUR ABSCHÄTZUNG VON LASTEN IN DER PYLON-FLÜGEL-SCHNITTSTELLE

Sebastian F. Zettel

Institut für Aeroelastik, Deutsches Zentrum für Luft- & Raumfahrt (DLR)

Sebastian F. Zettel, Deutsches Zentrum für Luft- & Raumfahrt, 01.10.2024



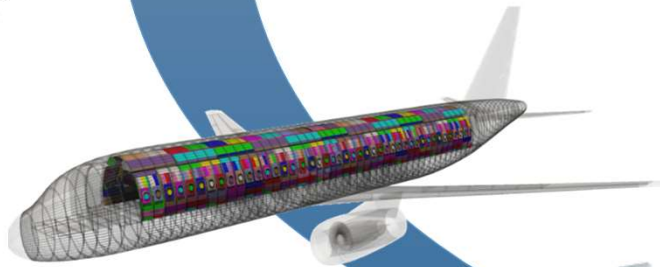
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30.09. – 02.10.2024 | HAMBURG



Flugzeugentwurf



Vibroakustisches
FE-Modell



INTONATE

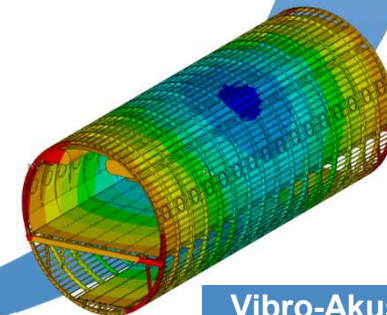
Geräuschquellen



VR-Umgebung



Vibro-Akustische
Analyse



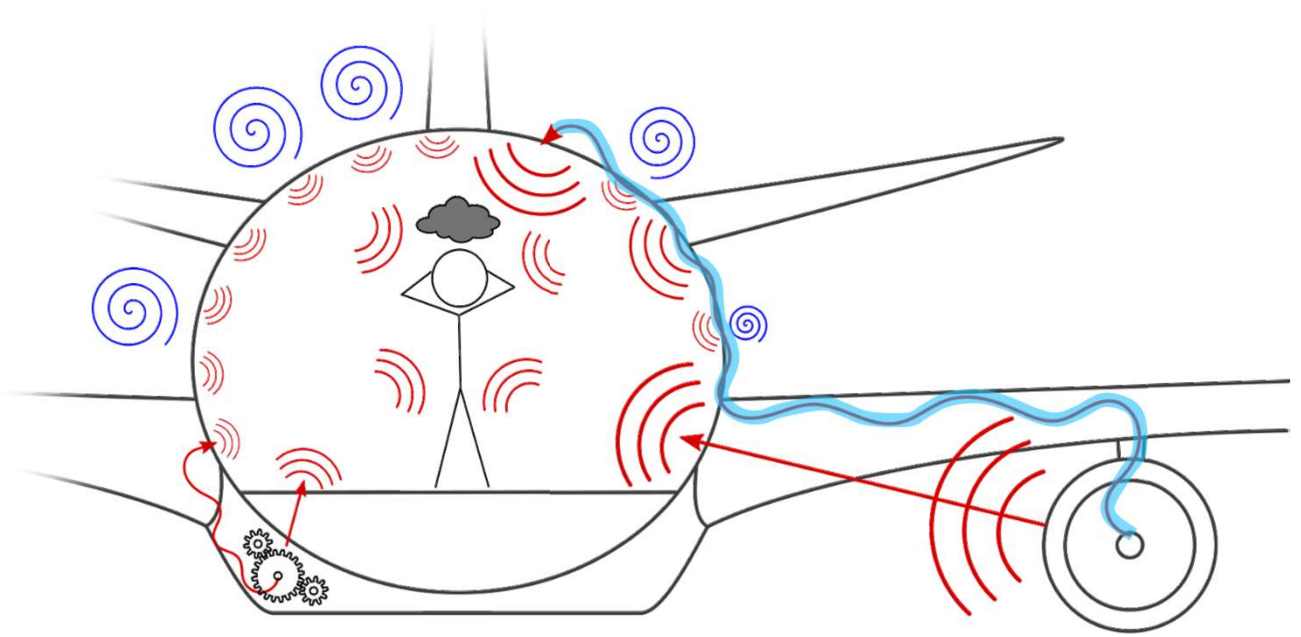
Neuartige Flugzeugentwürfe analysieren, bewerten und erleben.

Motivation

Cabin acoustics

Noise sources

- Turbulent boundary layer
- Engines & Subsystems
 - Noise transmission
 - Vibration induced noise



Flugzeugentwurf



Erweiterung einer VR-Umgebung zur Auralisation simulierten Innenlärms in Flugzeugen

Alexander Kokott

DLR, Institut für Systemleichtbau, Braunschweig

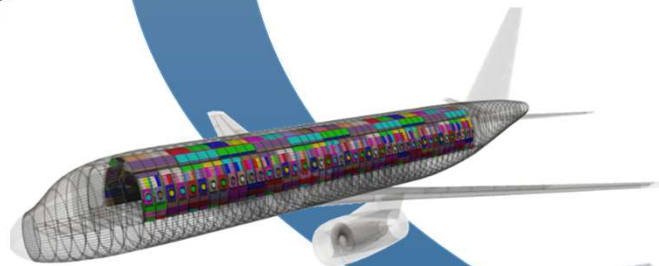
Heute, 02. Oktober 2024 von 09:45 bis 10:10

VR-Umgebung

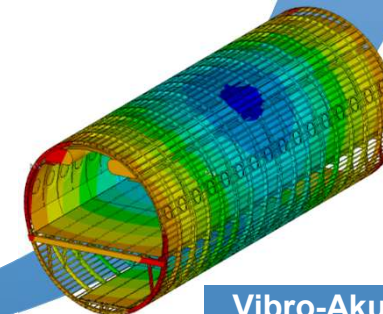


Geräuschquellen

Vibroakustisches
FE-Modell



Vibro-Akustische
Analyse



Neuartige Flugzeugentwürfe analysieren, bewerten und erleben.

MODEL DEVELOPMENT

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Model Development

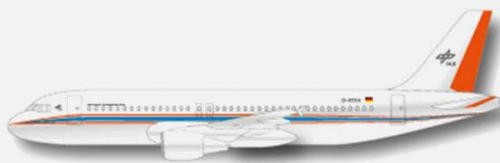
Gathering available data

Jet Engine Design Data



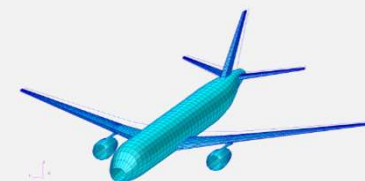
- V2500 jet engine design data
- Geometry, masses, etc.
- Maintenance documentation (build-up, components)

DLR ATRA Flight Data



- In-flight telemetry data
- Fuselage response during flight

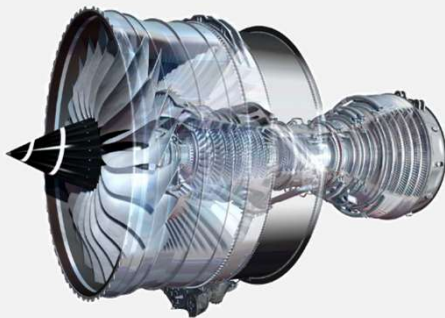
Available FEM models



- Structural parts for substitute model
- Engine model not available

Model Development

Concept idea



Jet engine with permissible
unbalance forces



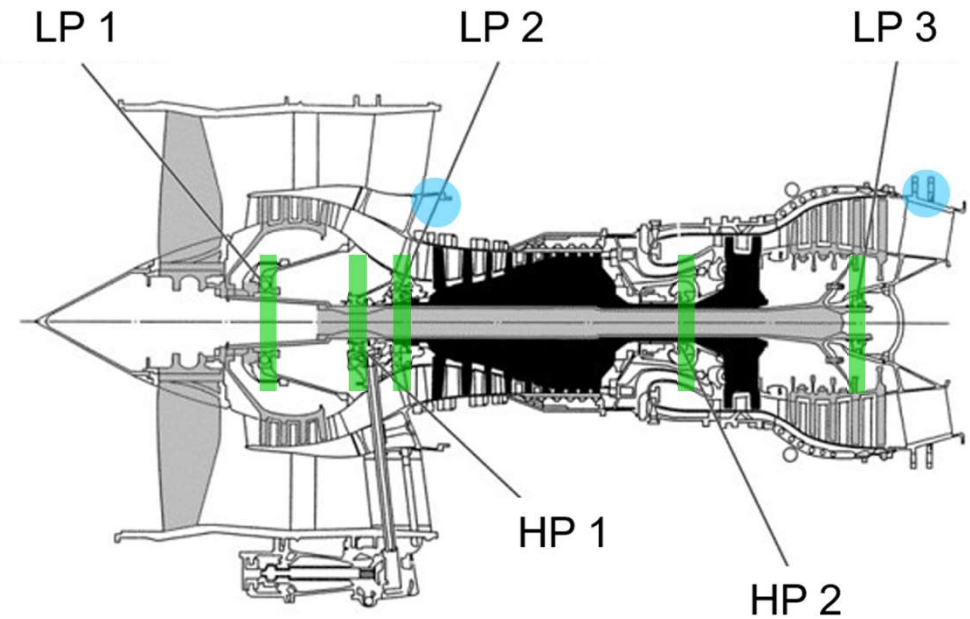
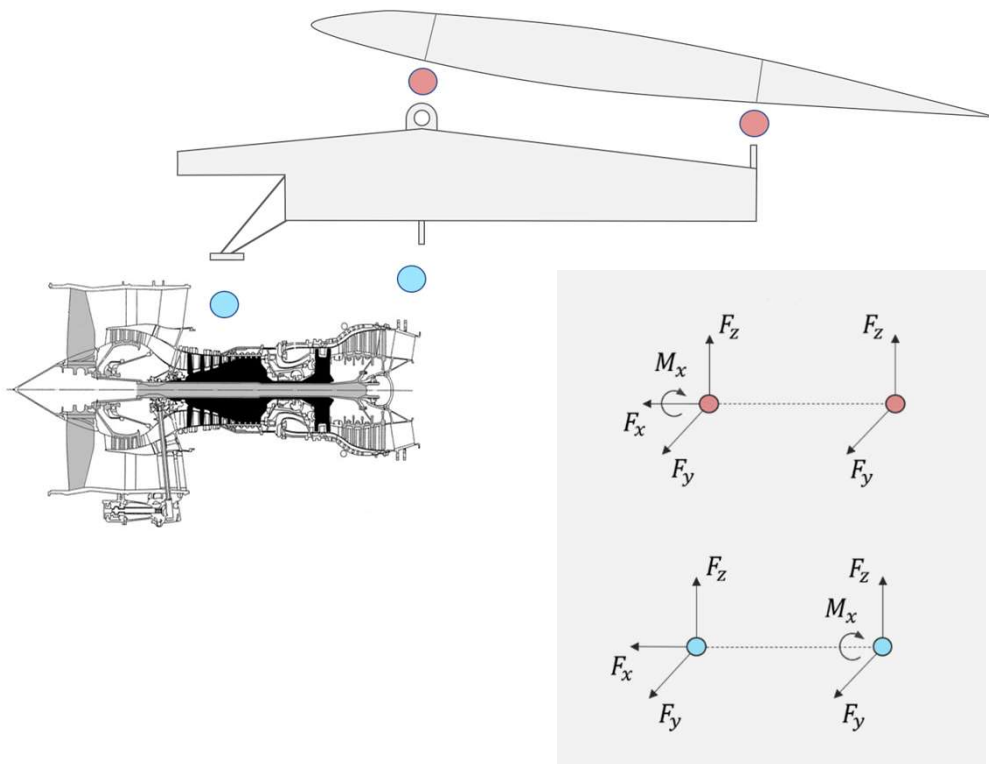
Jet engine design data
(Masses, Bearing locations, etc.)

DEUTSCHE NORM		April 2004
	DIN ISO 1940-1	
ICS 21.120.40	Ersatz für DIN ISO 1940-1:1993-12	
Mechanische Schwingungen – Anforderungen an die Auswuchtgüte von Rotoren in konstantem (starrem) Zustand – Teil 1: Festlegung und Nachprüfung der Unwuchttoleranz (ISO 1940-1:2003)		

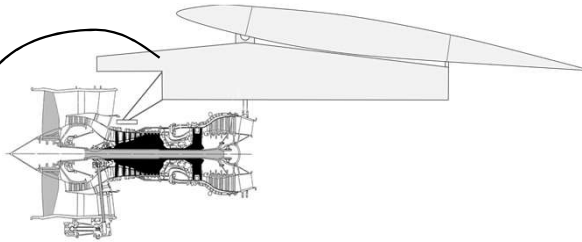
Calculation of permissible
unbalance forces

Model Development

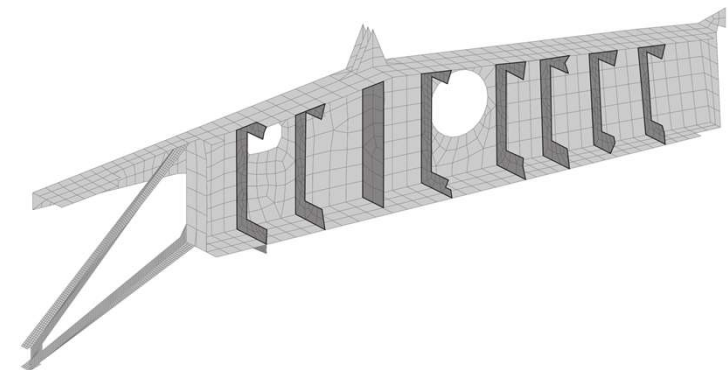
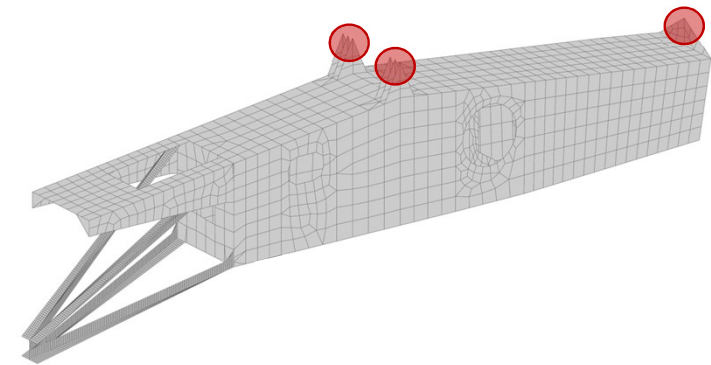
System overview



Model Development FEM model

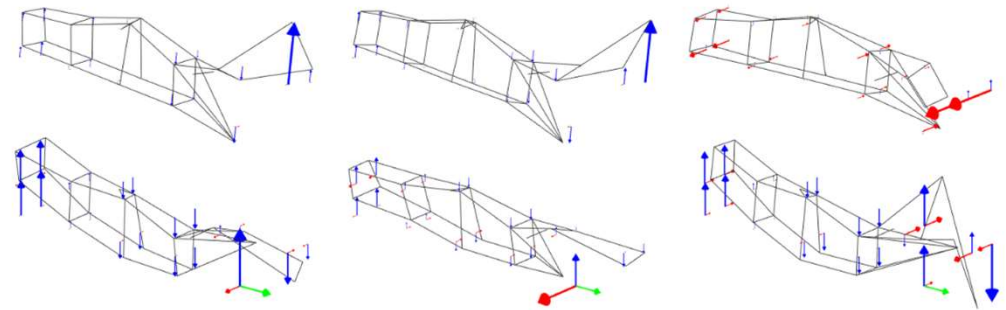


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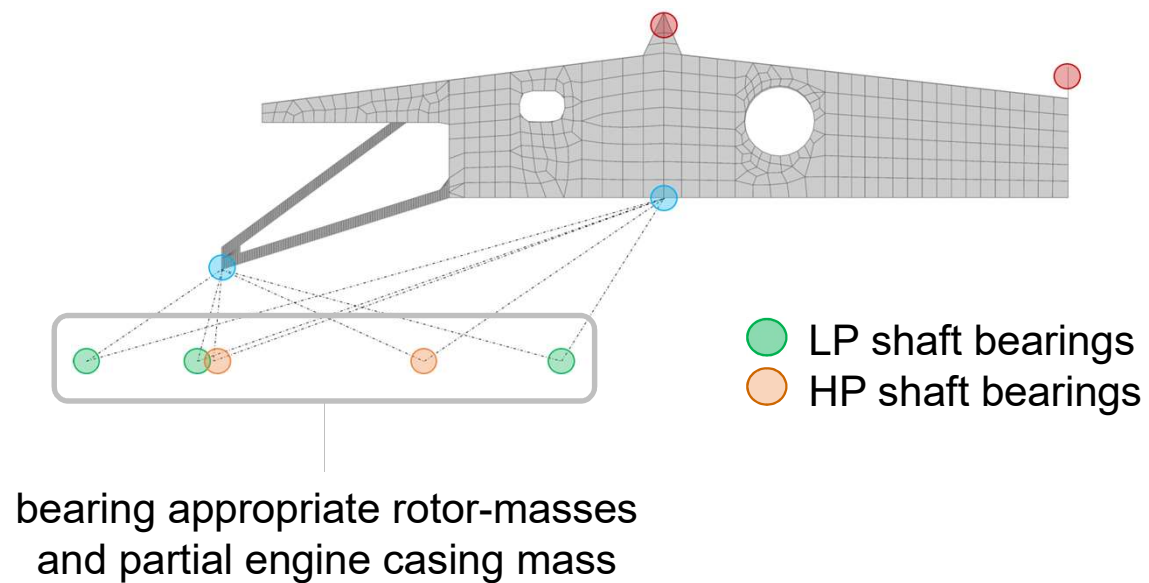
Model Development

Model updating



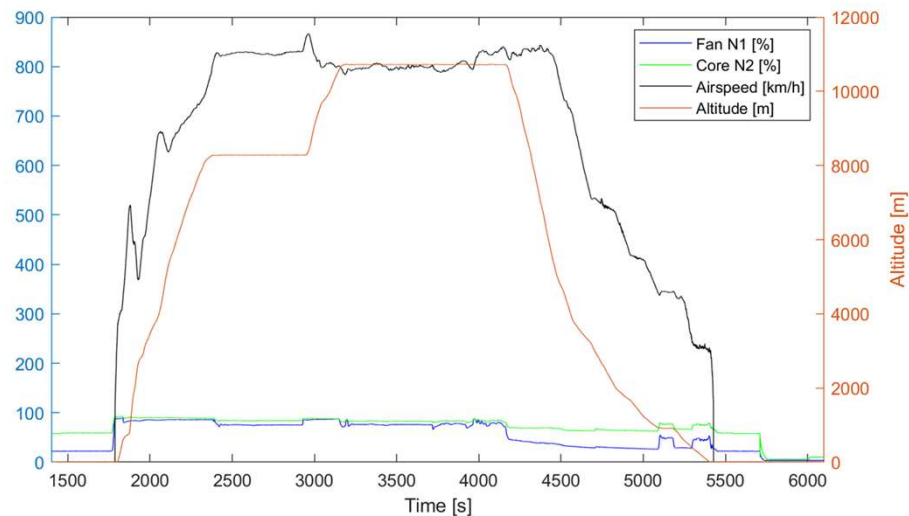
Model Development

FEM model engine substitution

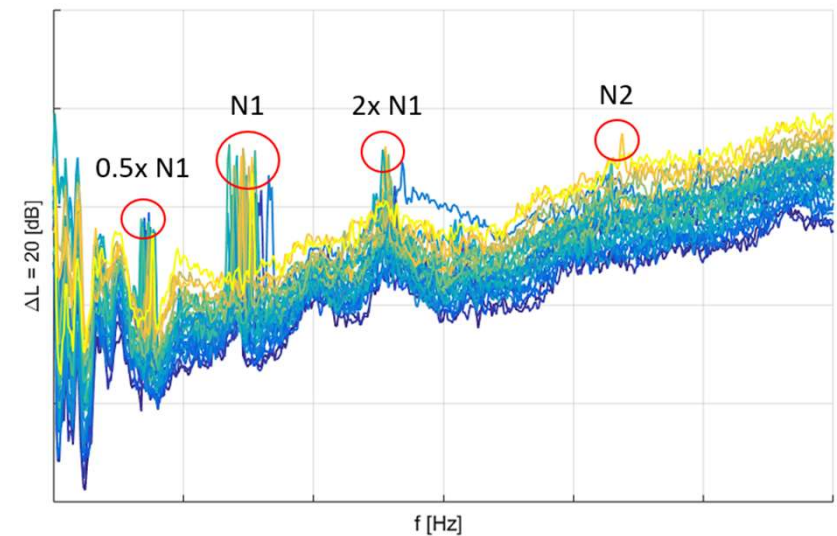


Model Development

Rotation speeds of interest



Flight condition	N1 (LP shaft)	N2 (HP shaft)
Take-off	88%	92%
Ascend	87%	88%
Cruise	76%	83%
Descend	30%	64%

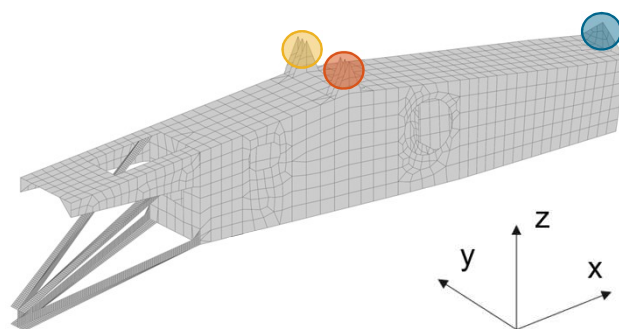
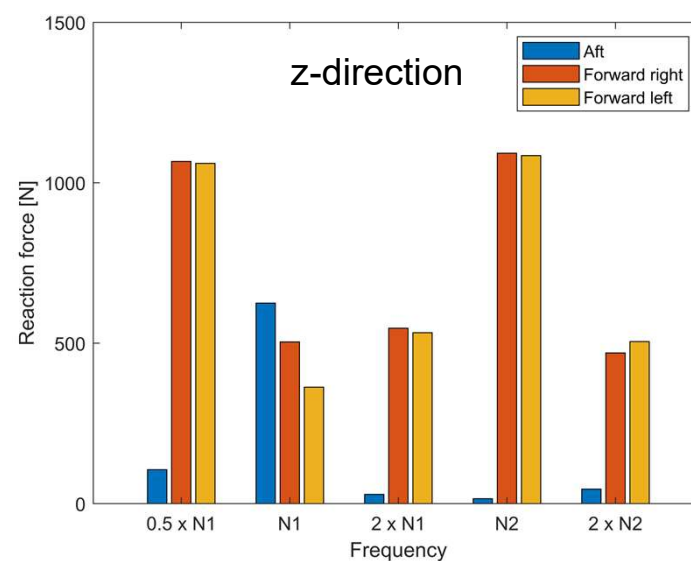
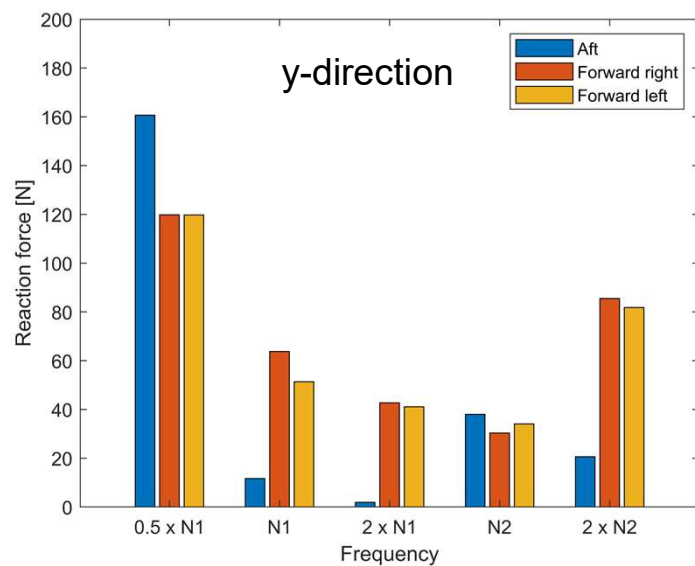


RESULTS

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Results

Loads at attachment points

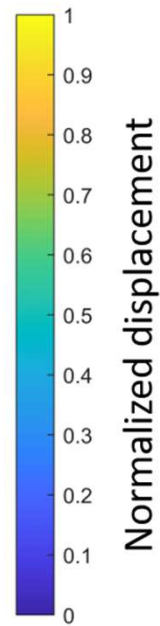
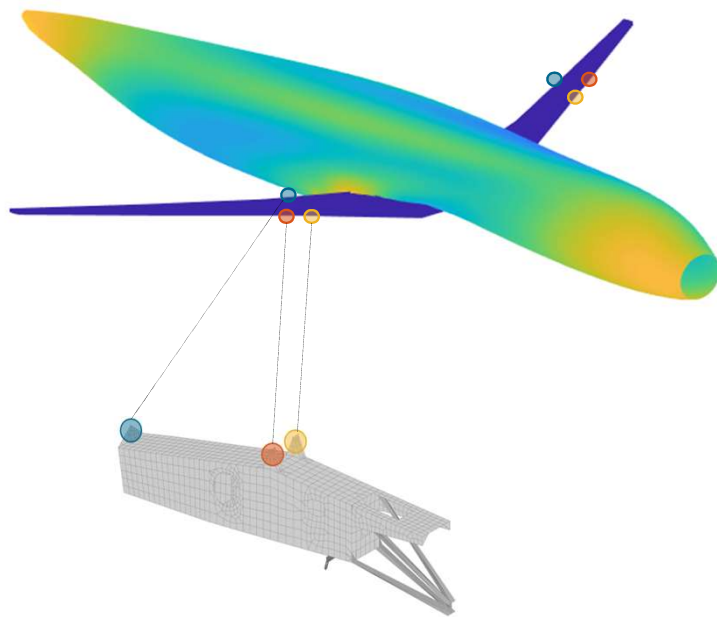


Results

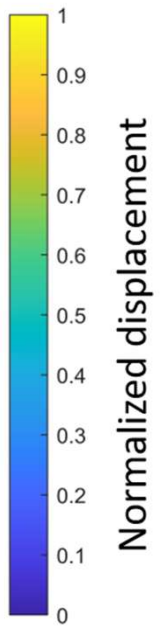
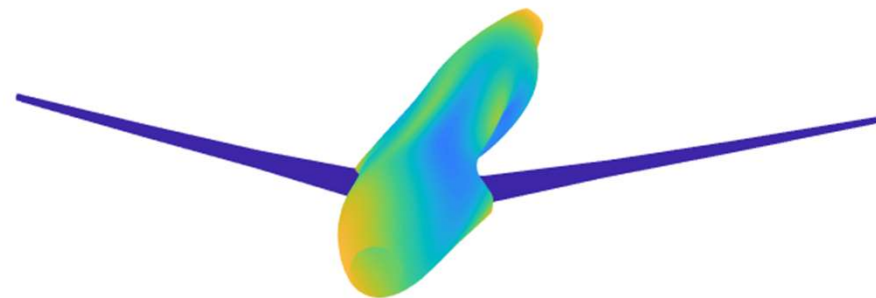
Aircraft model response



0.5 x N1



0.5 x N1

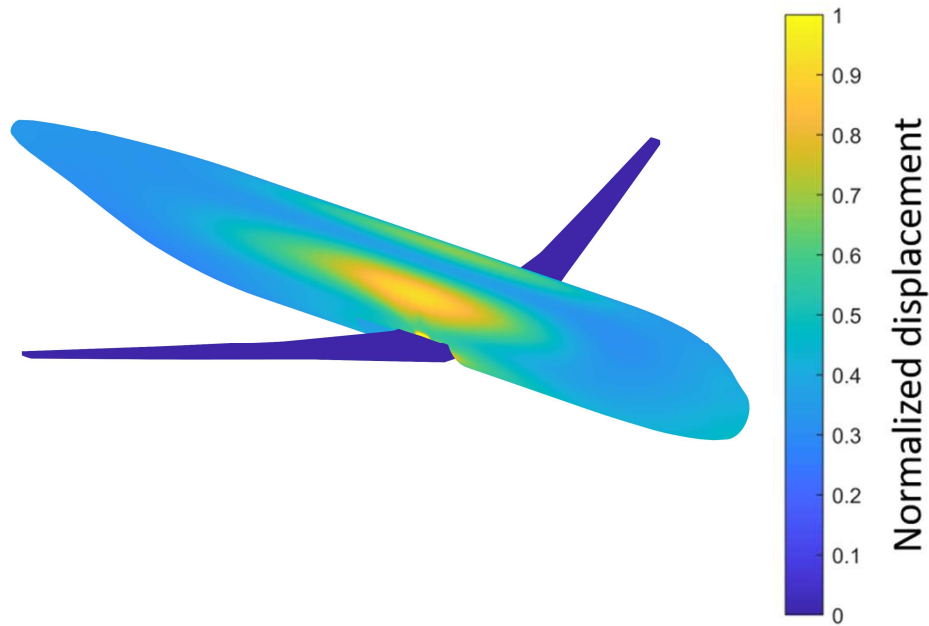


Results

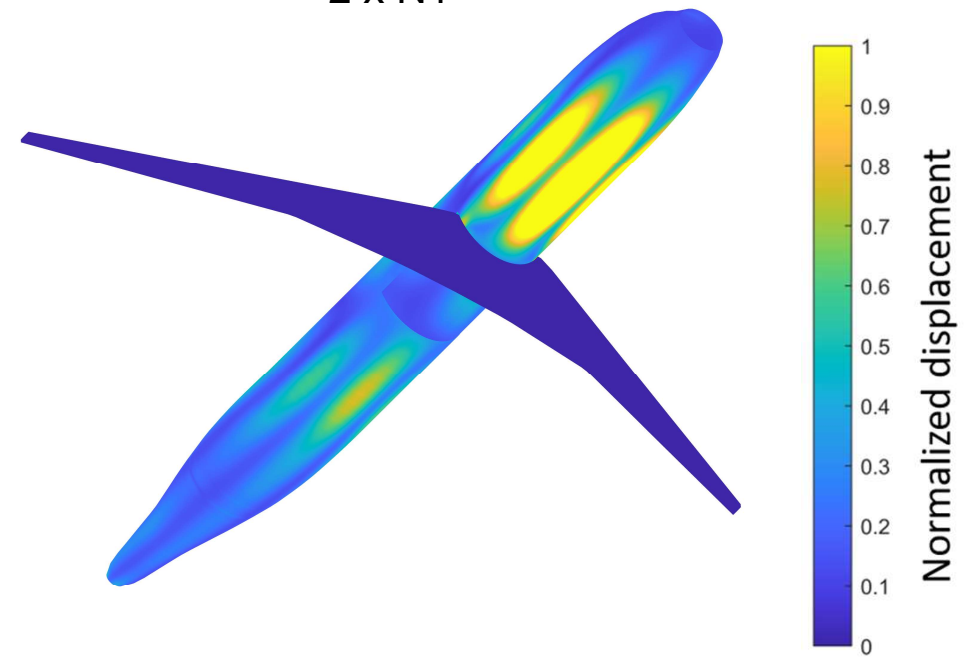
Aircraft model response



N1



2 x N1

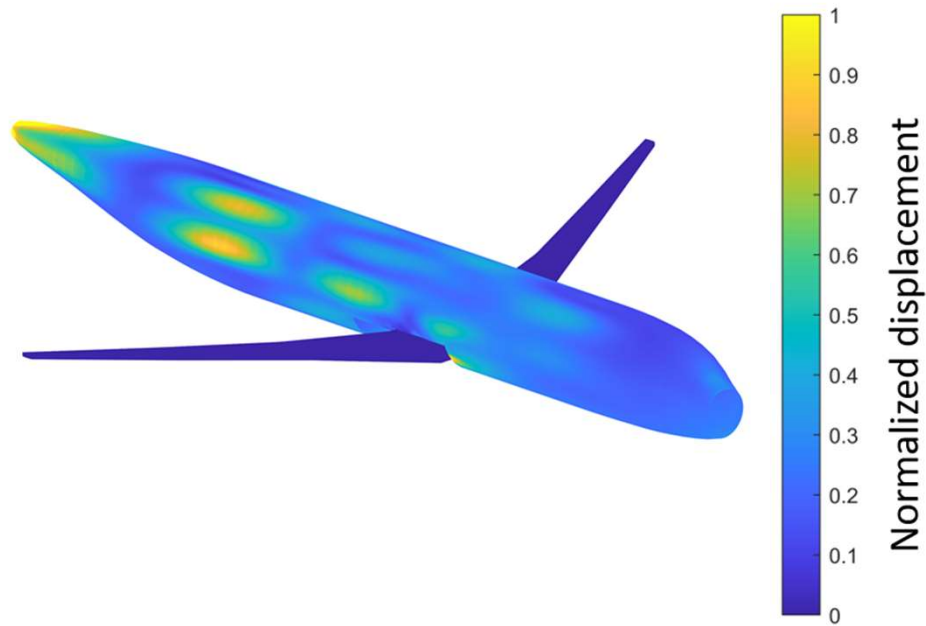


Results

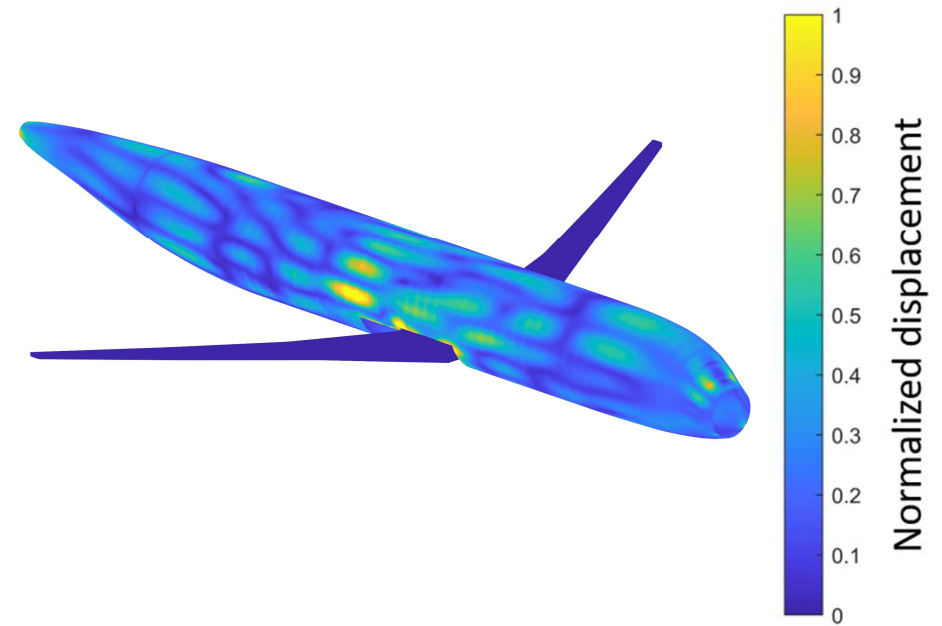
Aircraft model response



N2



2 x N2



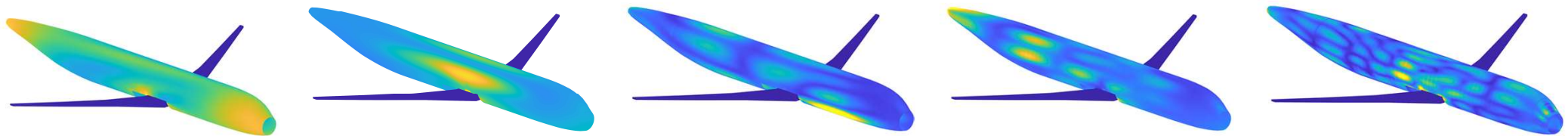
Summary



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- Engine vibration model allows to estimate excitation forces on wing
- Excitation forces at main engine speeds and their harmonics
- Full aircraft model excitation
 - Insights into frequency dependent local structural responses





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Thank you for your attention!

Sebastian F. Zettel

Institute of Aeroelasticity, Göttingen

Deutsches Zentrum für Luft- & Raumfahrt (DLR)

sebastian.zettel@dlr.de

Impressum



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Thema: Ein Modell für Triebwerksvibrationen zur Abschätzung von Lasten in der Pylon-Flügel-Schnittstelle

Datum: 01.10.2024

Autor: Sebastian F. Zettel

Institut: Institut für Aeroelastik

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