AeroGust Project Workshop

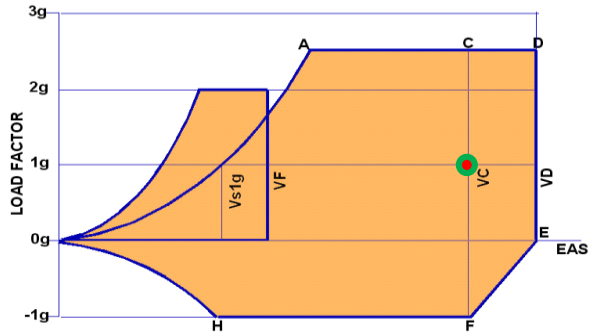
MOTIVATION FOR THE PROJECT:

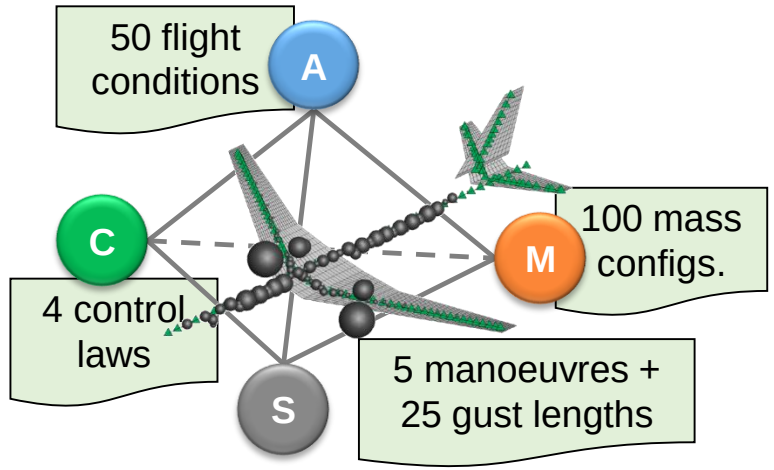
- To meet the challenges of emerging competitors and environmental targets, need to be able to rapidly adapt designs to future market drivers – FlightPath 2050.

- Requires improvements in the speed and fidelity of performance predictions for new designs as well as reduced reliance on costly wind tunnel testing, which tends to make it difficult to keep design solutions open.

BACKGROUND:

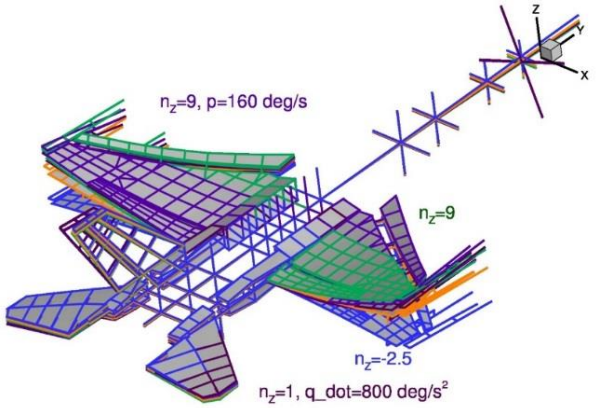
- Focus on one specific important area, namely to investigate and develop improved simulation methods for gusts.
- Important area for aerospace vehicle design, with gust loads often defining the maximum loads that these structures will experience in service
- Large number of gust load cases to be considered for each design together with the experimental data used in current processes.





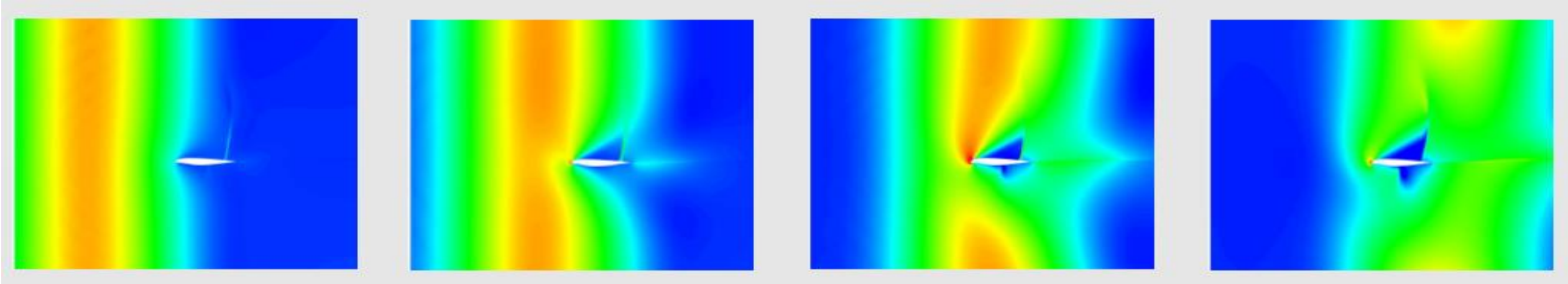
BACKGROUND:

- Current industrial processes have linearity assumptions – how to deal with more flexible materials and innovative configurations
- Gusts are also an important issue for wind turbine manufacturers - wind farm locations restricted by wind shear and gusts which create the largest loads on wind turbines



AEROGUST AIM

- To investigate and develop improved simulation methods for gusts



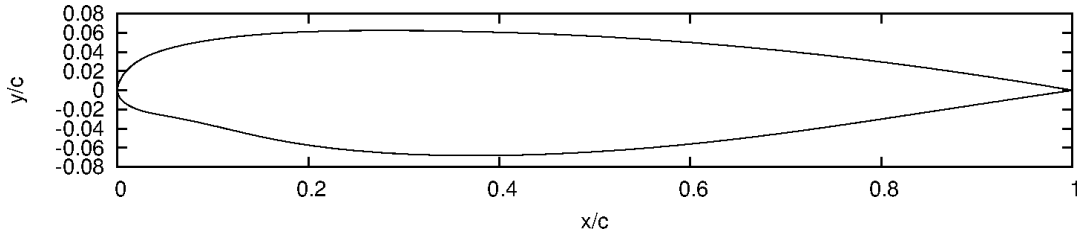
AEROGUST PARTNERS

- University of Bristol
- Institut National De Recherche En Informatique Et En Automatique (INRIA)
- Stichting Nationaal Lucht - En Ruimtevaartlaboratorium (NLR)
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
- University of Cape Town
- Numerical Mechanics Applications International SA (NUMECA)
- Optimad engineering s.r.l.
- University of Liverpool
- Airbus Defence and Space
- Dassault Aviation SA
- Piaggio Aero Industries SPA
- Valeol SAS

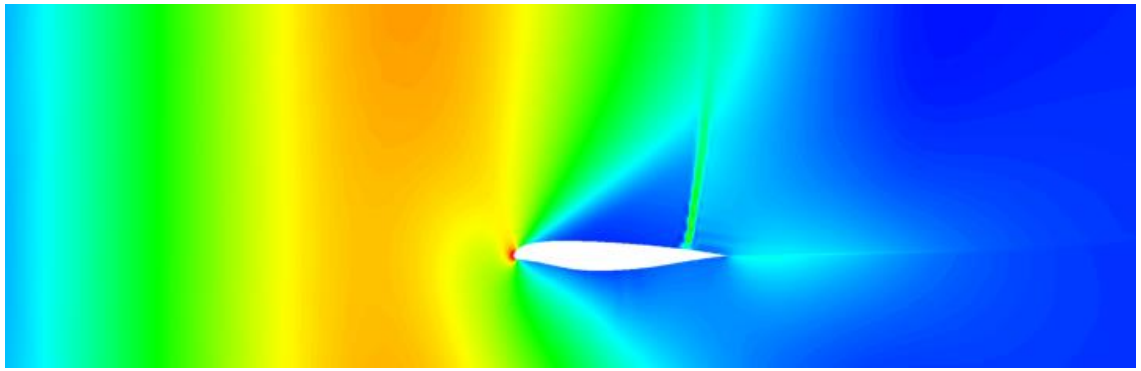
AEROGUST TEST CASES

- Initial model development on any available geometry
- 2D FFAST aerofoil
- Generic UAV
- NASA Common Research Model

2D FFAST aerofoil



- 8m Chord
- Pitch plunge structural model



Altitude 35000ft
Mach 0.754

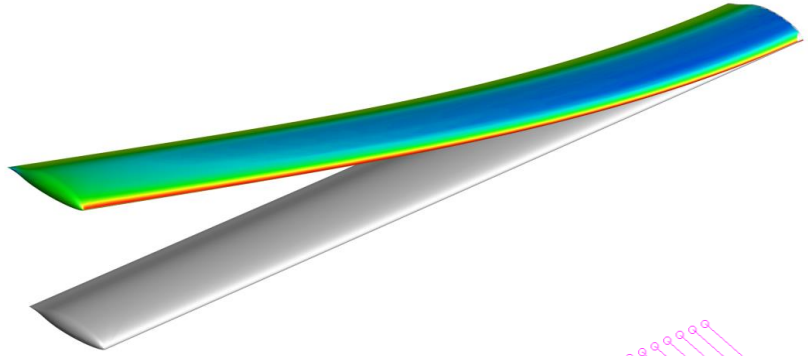
Case D		
Gust Length (m)	Gust velocity (m/s)	Equivalent AoA (degrees)
18.29	15.17	3.88
91.44	19.84	5.07
213.36	22.85	5.84

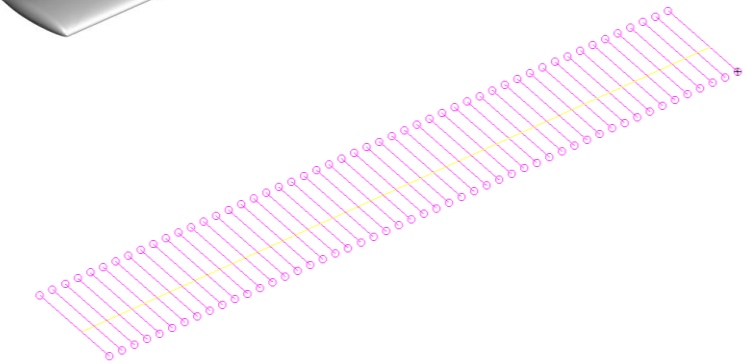
Altitude 35000ft
Mach 0.86

Case I		
Gust Length (m)	Gust velocity (m/s)	Equivalent AoA (degrees)
18.29	15.17	3.40
91.44	19.84	4.45
213.36	22.85	5.12

Generic UAV Wing

- Unswept, untapered wing
  - Span 25m
  - Chord 2m
  - Aerofoil NASA LRN 1015
- Beam stick model for Structure
- Aircraft mass 7000kg
- Flight conditions
  - Altitude 55000ft
  - Mach 0.55

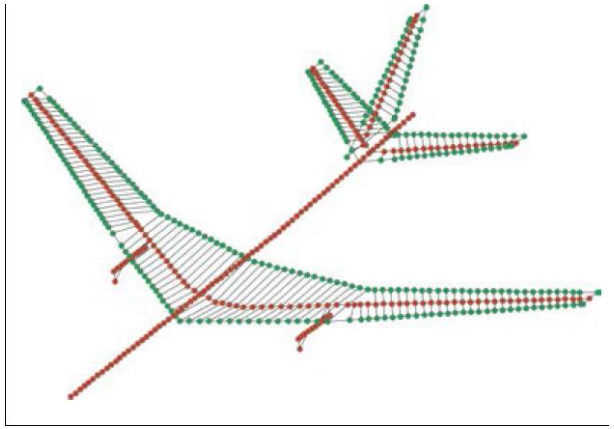


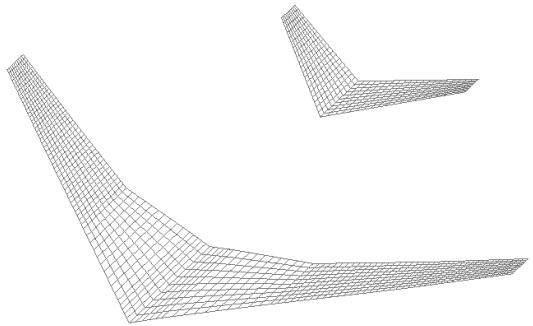


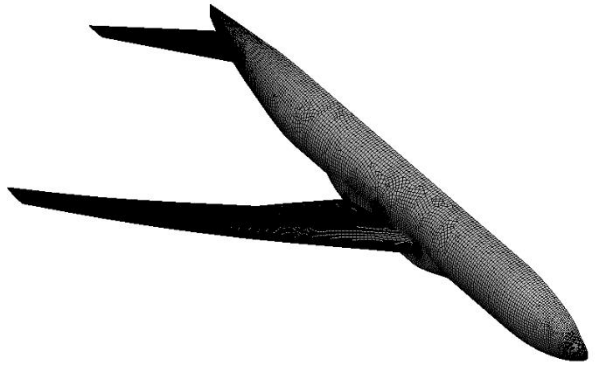
Gust Length (m)	Gust velocity (m/s)	Equivalent AoA (degrees)
18.29	11.71	4.12
91.44	15.31	5.39
213.36	17.63	6.20

NASA Common Research Model (CRM)

- NASA Common Research model, is a generic wide body aircraft
  - Span 58.764
  - MAC 7m
- FEM condensed mass and stiffness from FERMAT structural model, Maximum take off mass case
- DLM Mesh for wing and tail
- CFD mesh from 4th Drag Prediction Workshop
- Only wing coupled







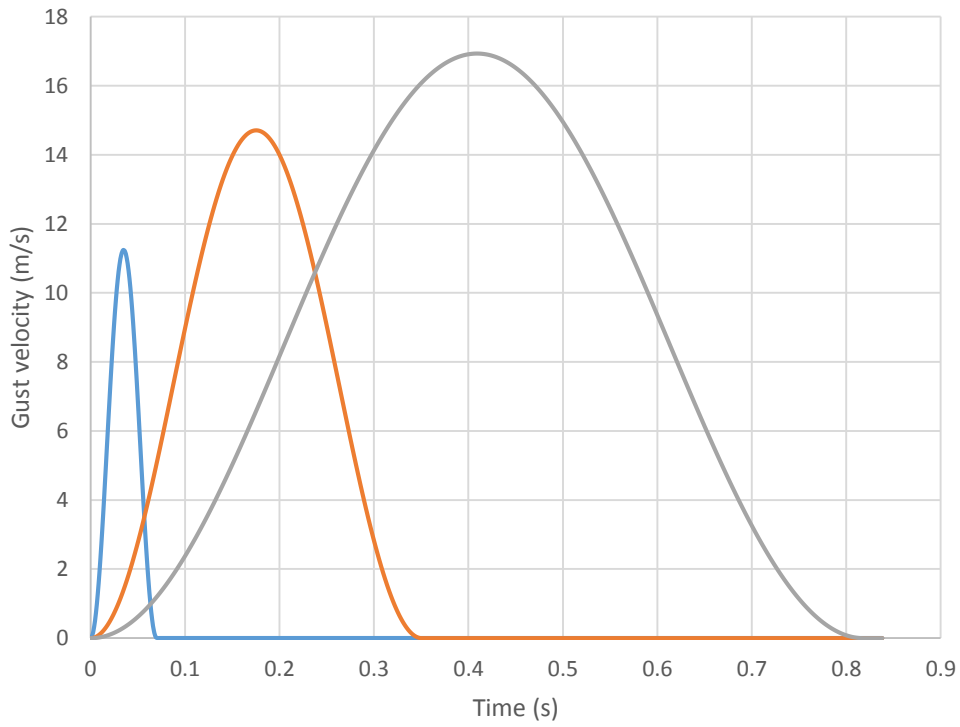
NCRM gust test case definitions

Altitude 0ft
Mach 0.499

Case F		
Gust Length (m)	Gust velocity (m/s)	Equivalent AoA (degrees)
18.29	8.82	2.97
91.44	11.54	3.89
213.36	13.29	4.47

Altitude 29995ft
Mach 0.86

Case H		
Gust Length (m)	Gust velocity (m/s)	Equivalent AoA (degrees)
18.29	11.24	2.47
91.44	14.70	3.23
213.36	16.94	3.72



AEROGUST PRESENTATIONS

- Non-linear time domain gust simulations
- Development of high-fidelity aeroelastic models for wind turbines
- Uncertainty quantification of aeroelastic systems with structural or aerodynamic nonlinearities
- Reduced Order Modelling for gusts
- Reduced reliance on wind tunnel data
- Industrial perspective

The research leading to this work has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 636053.