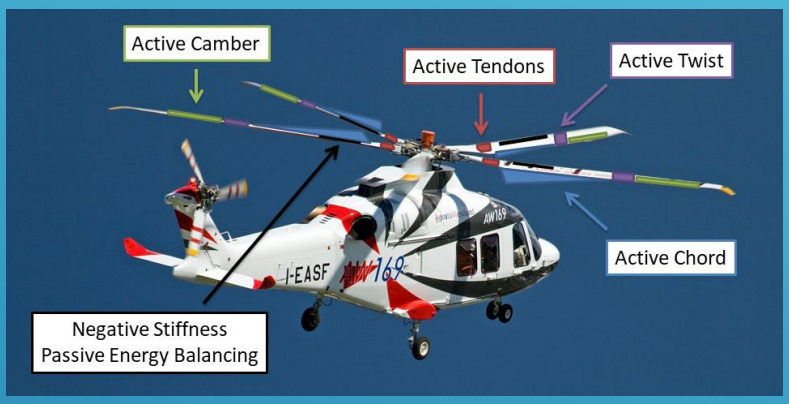
SABRE

Shape Adaptive Blades for Rotorcraft Efficiency

SABRE is an EU funded Horizon 2020 research program that has investigated the use of shape changing blades as a means of reducing the environmental impact of rotorcraft.

The SABRE vision of future rotorcraft:



Multiple morphing mechanisms optimise performance in all flight conditions =

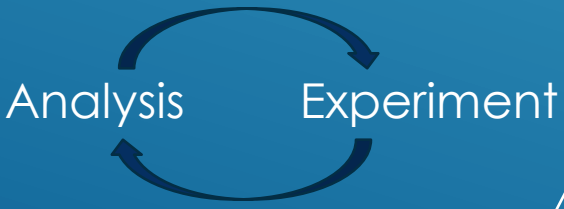
5-10% reduction in emissions

Two Coupled Research Questions:

- What is the best way for a rotor to change shape?
- What technologies can produce these shape changes?

SABRE addressed both questions simultaneously:

- Comprehensive rotor analysis and CFD to predict emissions (CO_2 , NO_x, noise)
- Rapid technology maturation of 6 different morphing concepts



The SABRE team:
>30 researchers from 6 partners in 4 countries.

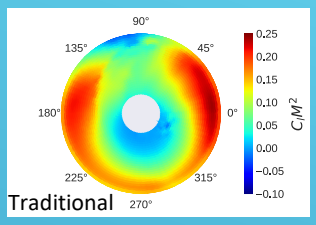
TU Delft
University of Bristol
Swansea University Prifysgol Abertawe
Technische Universität München
CIRA Centro Italiano Ricerche Aerospaziali
DLR

The extensive, multi-disciplinary research within SABRE produced the following results:

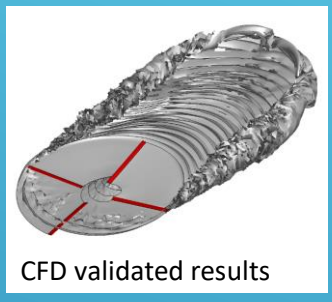
Analysis Results

- Extensive comprehensive analysis
  - Optimised location and actuation scheduling for morphing
- Predicted 5-11% reduced fuel burn:
  - Twist + chord during hover
  - Camber change in forward flight
- High fidelity CFD coupled with FE
  - Detailed understanding of physics
  - Noise predictions, morphing can also be quieter: -4dB in forward flight

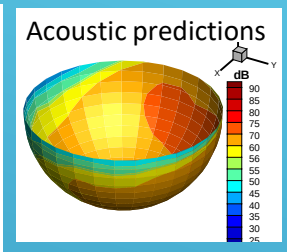
Bo-105 helicopter used in our studies



Comprehensive analysis shows more uniform flow

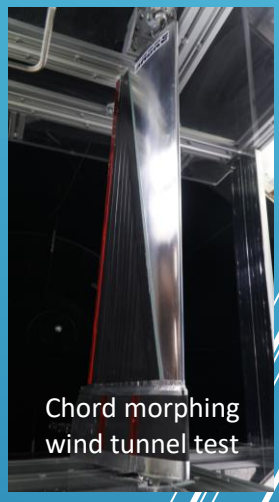


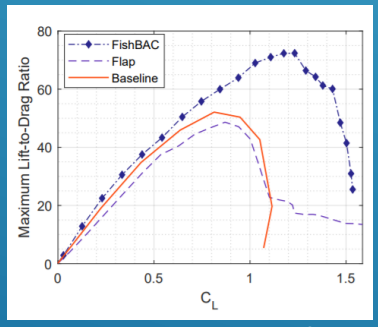
CFD validated results



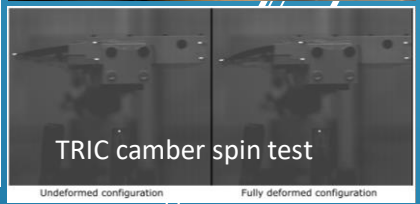
Experimental Results

- 4x successful wind tunnel tests
- 4x successful whirl tower tests
- Experimentally demonstrated morphing capabilities:
  - Camber change: $\Delta C_L = 0.55$
  - Active twist = 2° per meter
  - Chord increased by 30+%
  - Control of dynamic modes
- Actuation systems proven





FishBAC vs traditional flaps



Overall Assessment:

SABRE has shown that adaptive blades can make a significant contribution to rotorcraft sustainability. The technologies show promising performance, motivating further development.

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