



Universidad de Oviedo

OPTIMIZATION OF WIND TURBINE AIRFOILS USING GEOMETRIES BASED ON HUMPBACK WHALE FLIPPERS

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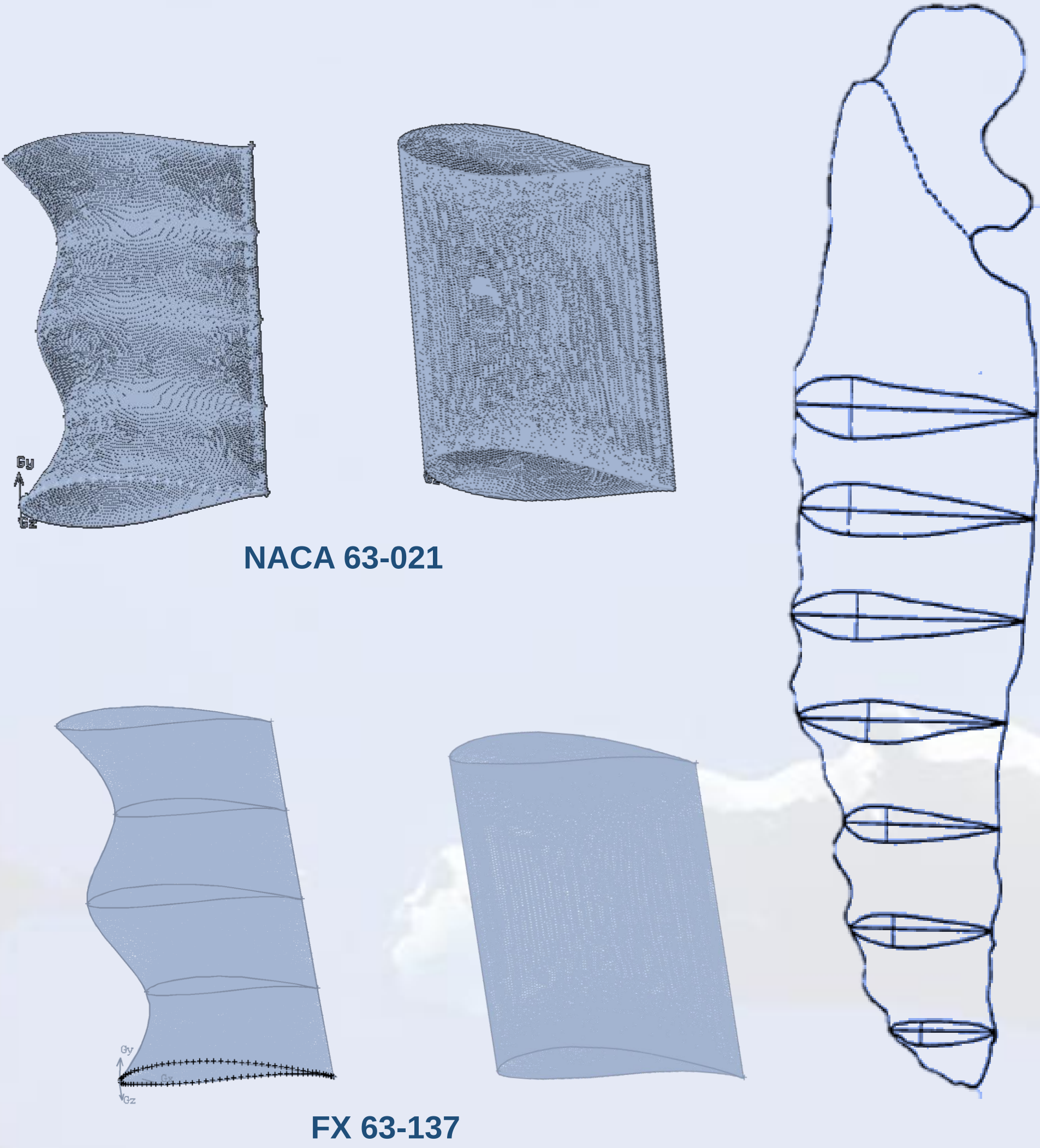
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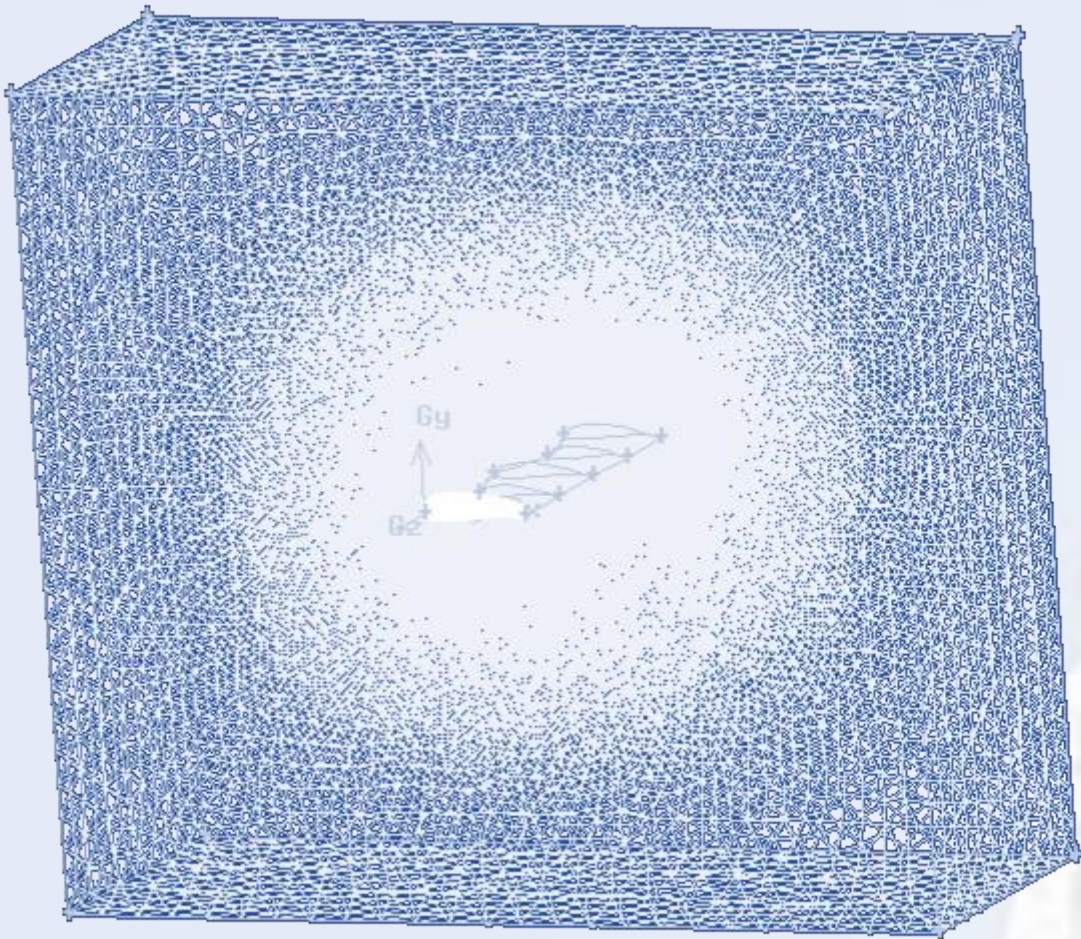
Introduction



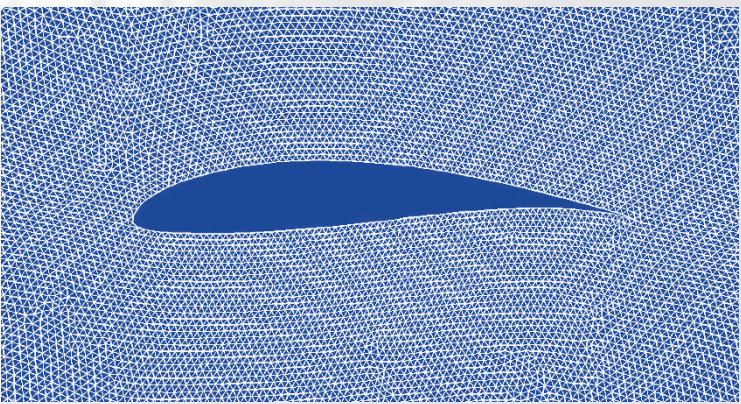
The whale flipper tubercles appear to control the flow, generating vortexes which attach the flow to the airfoil surface. This behaviour delays the stall and keeps the lift coefficient uniform. The aim of this work is to test this effect in typical wind turbine airfoils.



Methodology



- Mesh: Non-structured, consisting of around 900,000 elements.
- Turbulence Model: K- ω SST
- Angles of attack:
5° 10° 12.5° 15°
20° 25° 27.5° 30°
- Reynolds number: 350,000



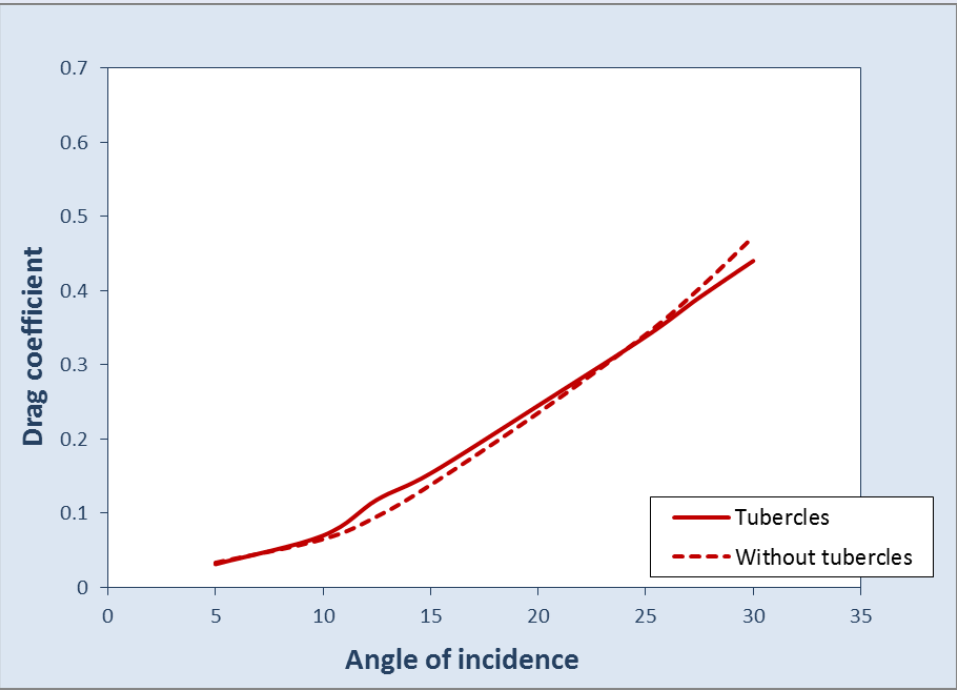
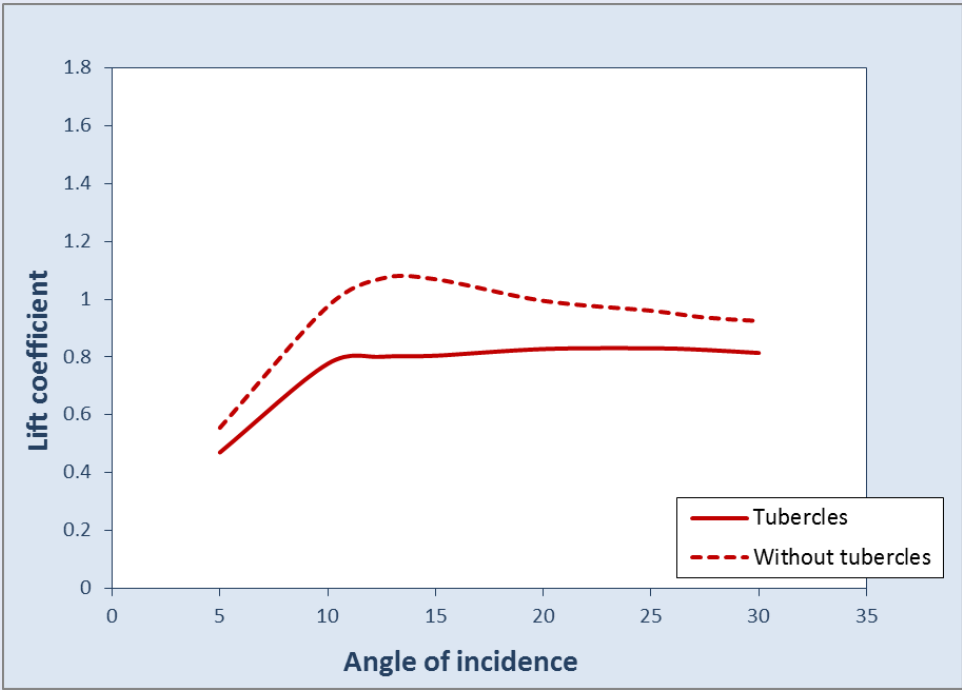
	NACA	FX 63-137
c	0.305	0.305
A	0.0305	0.061
λ	0.5	0.5

The Humpback Whale, *Megaptera novaeangliae*

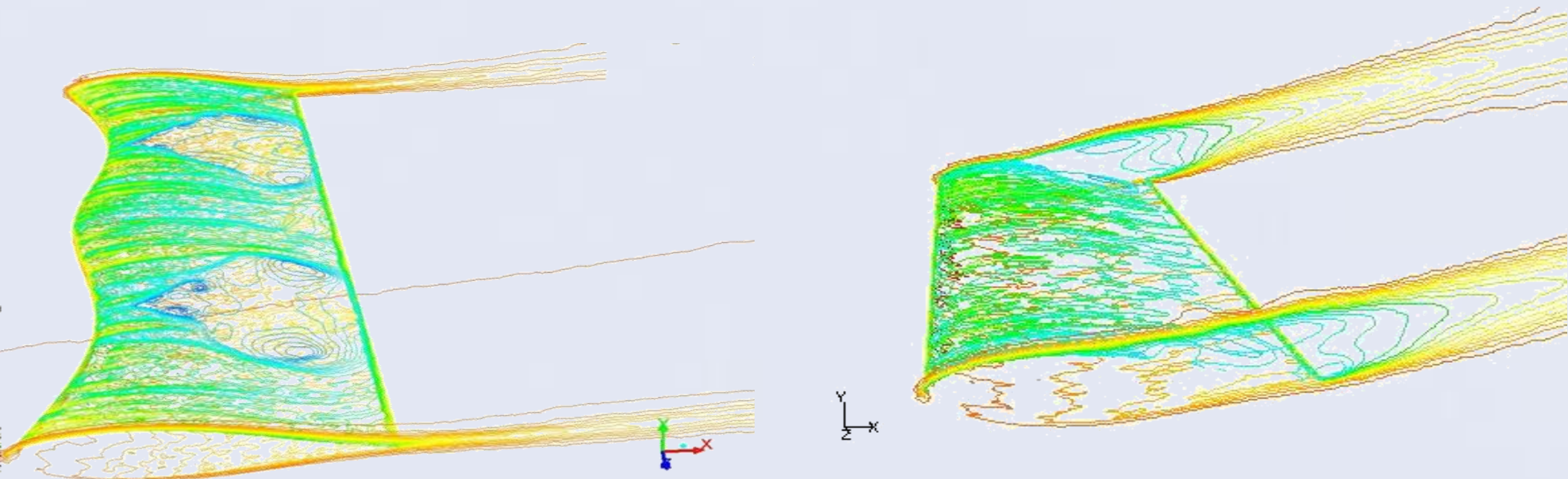
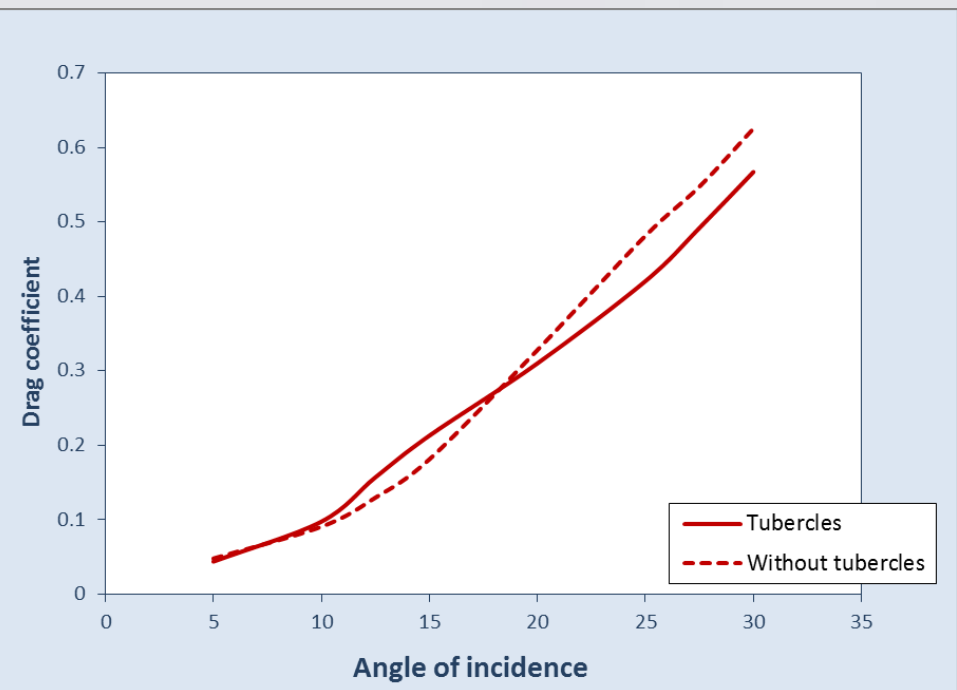
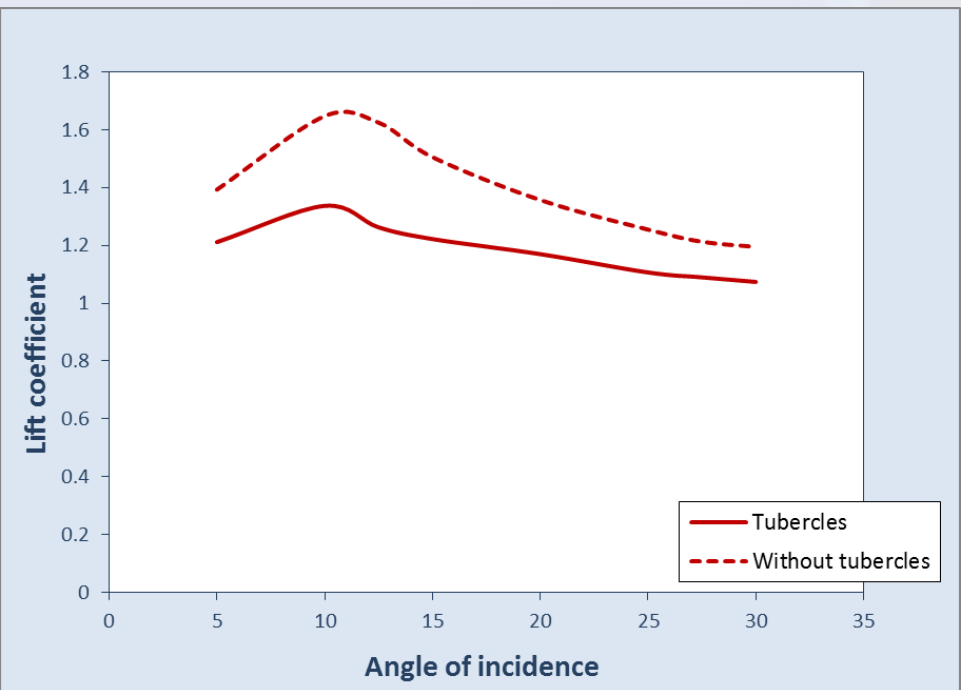


Results

NACA 63-021



FX 63-137



Angle of 12.5° with (left) and without (right) tubercles for a NACA 63-021.

Conclusions



The NACA 63-021 airfoil with tubercles delays the stall around 13° from the stall angle of the smooth one, keeping the lift coefficient uniform afterwards. The FX 63-137 airfoil does not show this behaviour.

This effect is very useful for preventing stall in vertical turbines which operate at low Reynolds numbers and high angles of incidence.



Acknowledgements

This work has been supported by Project “Caracterización y predicción de la generación aerodinámica de ruido en perfiles de turbinas eólicas”, DPI2011-25419 by the Spanish Ministry of Economy and Competitiveness and “Severo Ochoa” predoctoral research grant provided by the Principality of Asturias, Spain.



International Congress

Energy and Environment Engineering and Management

Paris
22nd - 24th July 2015

