Fatigue loads alleviation by morphing blades for tidal turbine

Gabriele Pisetta, Dr. Ignazio Maria Viola

Wind & Marine Energy Systems CDT, Rm 3.36, Royal College Building
University of Strathclyde, 204 George Street, Glasgow, G1 1XW

gabriele.pisetta@ed.ac.uk

Introduction – Fatigue loads

The blades of axial-flow horizontal-axis tidal and wind turbines experience continuous flow fluctuations which are set to increase with the scale up to larger turbines and the increased use of floating platforms [1,2].

This results in thick and expensive structures with short fatigue life, which are key issues for the wind and tidal energy sectors. In particular, while decreasing load fluctuations is critical for the wind industry in order to decrease the levelised cost of energy [3], reliability is one of the main technological goals of the tidal industry [4].

Supervisory team

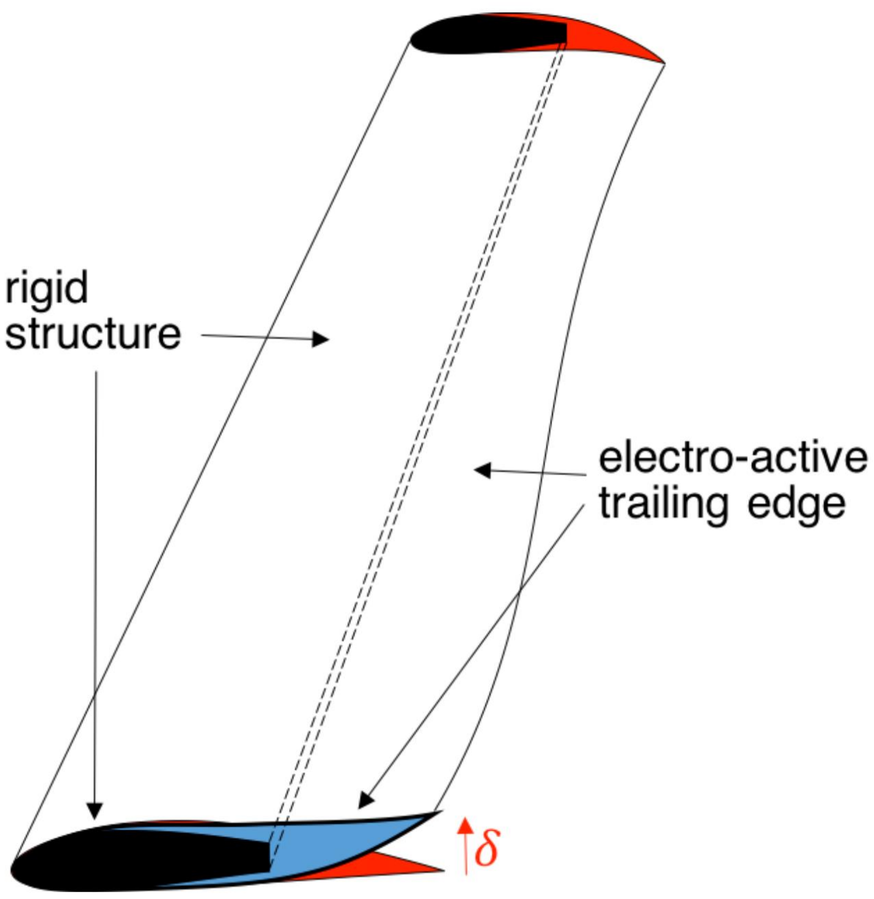
- Dr. Ignazio Maria Viola (University of Edinburgh)
- Prof. Michael Graham (Imperial College, London)
- Peter Jamieson (University of Strathclyde)

Industrial partners

SRI International

NOVA INNOVATION

Adaptive Trailing Edge concept



Research objective

The aim of this PhD project is to develop and intelligent blade concept, that will cancel fatigue loads through a high frequency shape morphing.

Adaptive trailing edge concept:

- Better structural integrity
- Better aerodynamic efficiency
- Passive/active implementation
- Smart-actuation technology (electro-active polymers, electro-laminates)

Methodology

The focus of the project is to acquire an in-depth understanding of the unsteady fluid dynamics of tidal turbines, develop a numerical model of a morphing blade, extensively study the model via Computational Fluid Dynamic and finally perform proof of concept experiments in the FloWave facility.

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2. Buhl, Thomas, Mac Gaunaa, and Christian Bak. "Potential load reduction using airfoils with variable trailing edge geometry." Journal of Solar Energy Engineering 127.4 (2005): 503-516.
3. Barlas, Thanasis K., and G. A. M. Van Kuik. "Review of state of the art in smart rotor control research for wind turbines." Progress in Aerospace Sciences 46.1 (2010): 1-27.
4. Badcock-Broe, A., et al. "Wave and tidal energy market deployment strategy for Europe." SI Ocean (2014).