

## Ducted wind turbine optimization

### A numerical approach

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#### Publication date

2017

#### Document Version

Final published version

#### Citation (APA)

Dighe, V., De Oliveira Andrade, G., & van Bussel, G. (2017). *Ducted wind turbine optimization: A numerical approach*. 177-177. Abstract from Wind Energy Science Conference 2017, Lyngby, Denmark.

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# **WESC2017 - DTU COPENHAGEN 2017**



## **BOOK OF ABSTRACTS**

WESC2017 – Wind Energy Science Conference  
Technical University of Denmark, Lyngby  
June 26<sup>th</sup> – 29<sup>th</sup>, 2017

# Preface

Wind Energy Science Conference 2017 (WESC-2017) is held at the Technical University of Denmark in Lyngby during June 26-29, 2017. This conference is the first of a series of bi-annual conferences launched by the European Academy of Wind Energy (EAWE). The purpose of the conference is to gather leading scientists and researchers in the field of wind energy to present their latest findings. The conference aims at covering all scientific topics in wind energy, comprising from most fundamental aspects to recent applications. It provides a world-wide forum for scientists to meet each other and exchange information of all aspects of wind energy, including aerodynamics, turbulence, wind resource assessment, wind farms and wakes, aero-serve-elasticity, loads, structural mechanics, control, operation and maintenance, generator technology, grid integration, structural design and materials, new concepts, as well as community acceptance, environmental aspects, and economics.

This volume of abstracts comprises all presentations of the conference, including two plenary lectures, and nearly 370 contributed papers, presented in either oral sessions or during 13 mini symposia. The abstracts are sorted chronologically after the day of presentation, corresponding to the way they appear in the conference programme. At the end of the book you will find a list of presenting authors, listed alphabetically, and the page number where their abstract appear.

I like to thank the scientific committee and the local organizing committee for their work with the evaluation and selection process. In particular, I thank Marianne Hjorthede Arbirk for her invaluable help in preparing the conference and this book of abstracts.

Jens N. Sørensen, chairman WESC-2017  
Lyngby, June 2017

Keywords: numerical simulation, actuator disc  
M13: Advances in Ducted Rotor Research

## Ducted wind turbine optimization: A numerical approach

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The practice of ducting wind turbines has shown a beneficial effect on the overall performance, when compared to an open turbine of the same rotor diameter<sup>1</sup>. However, an optimization study specifically for ducted wind turbines (DWT's) is missing or incomplete. This work focuses on a numerical optimization of the duct orientation and the ideal loading coefficient for the rotor. A 2D planar geometry was employed to model the DWT and the rotor is modelled as an uniformly loaded actuator disc (AD). The flow-field around the DWT is obtained through numerical solutions of Reynolds-averaged-Navier-Stokes (RANS) equations<sup>2</sup> and a steady state Lagrangian approach based on vortex ring method<sup>3</sup>. The study determines the optimal angle of attack for the duct corresponding to the AD loading, in order to achieve the optimal performance for a given DWT configuration.

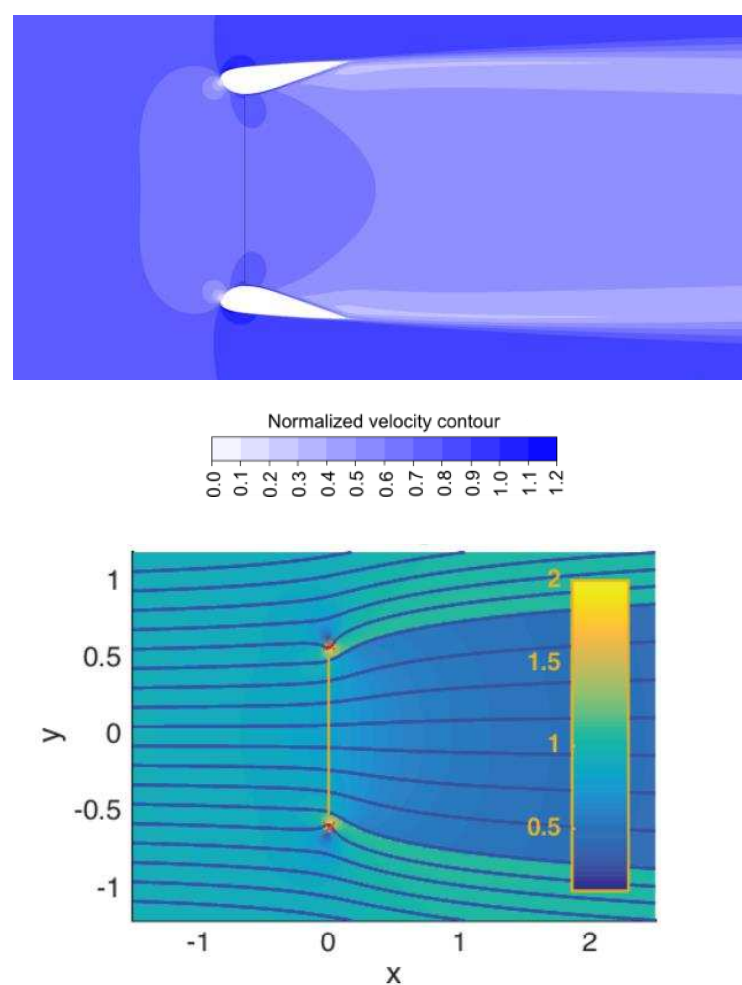


Figure: Velocity contours for the DWT configuration. (top) Flow field around a DWT model obtained using RANS solution and (bottom) flow field streamlines obtained using the Lagrangian approach with duct represented by surrounding vortex pair.

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<sup>1</sup> Van Bussel, G. J. (2007). The science of making more torque from wind: Diffuser experiments and theory revisited. In *Journal of Physics: Conference Series* (Vol. 75, No. 1, p. 012010). IOP Publishing.<sup>2</sup> Dabbs et al., *Phys. Fluids* **18**, 034210 (2006)

<sup>2</sup>Dighe, V. V., Avallone, F., Tang, J., & van Bussel, G. (2017). Effects of Gurney Flaps on the Performance of Diffuser Augmented Wind Turbine. In *35th Wind Energy Symposium* (p. 1382).

<sup>3</sup>de Oliveira, G., Pereira, R. B., Ragni, D., Avallone, F., & van Bussel, G. (2016, September). How does the presence of a body affect the performance of an actuator disk?. In *Journal of Physics: Conference Series* (Vol. 753, No. 2, p. 022005). IOP Publishing.