Accepted Manuscript

A Tuned Actuator Cylinder Approach for Predicting Cross-Flow Turbine Performance with Wake Interaction and Channel Blockage Effects

Michael Shives, Curran Crawford, Shane Grovue

 PII:
 S2214-1669(17)30029-2

 DOI:
 http://dx.doi.org/10.1016/j.ijome.2017.03.007

 Reference:
 IJOME 147

To appear in:

Received Date:	18 October 2016
Revised Date:	20 March 2017
Accepted Date:	27 March 2017



Please cite this article as: M. Shives, C. Crawford, S. Grovue, A Tuned Actuator Cylinder Approach for Predicting Cross-Flow Turbine Performance with Wake Interaction and Channel Blockage Effects, (2017), doi: http://dx.doi.org/10.1016/j.ijome.2017.03.007

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

A Tuned Actuator Cylinder Approach for Predicting Cross-Flow Turbine Performance with Wake Interaction and Channel Blockage Effects

Michael Shives¹, Curran Crawford²

Dept. Mech. Eng., University of Victoria PO Box 3055 STN CSC, Victoria, BC, Canada, V8W 2Y2

Shane Grovue³

Instream Energy Systems Corp. 1080-1140 West Pender St., Vancouver, BC, V6E 4G1

Abstract

This article presents a practical method for predicting the power output of crossflow tidal/river turbines with wake interaction and channel blockage effects. In a turbine farm, the power generated by each rotor depends on the cube of the local velocity, which is influenced by the bottom topology, by other turbines' wakes and also by finite channel cross sectional areas restricting wake expansion. Therefore, the accuracy of power predictions depends strongly on proper modelling of rotor wakes and the influence of the channel/river boundaries. This is a critical issue for the tidal and river kinetic turbine power industries because best practise for predicting energy yield has yet to be established, while project revenue streams are primarily a function of yield.

This article introduces a simulation-based method to predict individual turbine and total farm power output with modest computational expense, named the *tuned actuator cylinder approach* (TACA). Rotors are represented in the simulations as momentum sink terms, using approximately 21 elements across their diameter, allowing for very fast simulations of multiple rotors. The model is tuned to match known (from experiments or high-fidelity blade-resolved simulation) thrust and power operational profiles for a particular turbine, with known inflow conditions. Once tuned, the TACA model can be applied to a wide range of turbine array configurations, and arbitrary flow environments. Thus, TACA is an appropriate tool for case-studies and/or optimization of turbine array layout at real-world tidal/river energy sites.

Keywords: actuator cylinder, RANS, turbine farm, simulation, tidal, river

¹mrshives@uvic.ca

²curranc@uvic.ca

³s.grovue@instreamenergy.com

Download English Version:

https://daneshyari.com/en/article/5473564

Download Persian Version:

https://daneshyari.com/article/5473564

Daneshyari.com