IEA Wind Task 37 System Modeling Framework and Ontology for Wind Turbines and Plants

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BOOK OF ABSTRACTS

WESC2017 – Wind Energy Science Conference
Technical University of Denmark, Lyngby
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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

M9: Design and Systems Engineering of Wind Turbines and Plants

IEA Wind Task 37 System Modeling Framework and Ontology for Wind Turbines and Plants

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This presentation will provide an overview of progress to date in the development of a system modeling framework and ontology for wind turbines and plants as part of the larger IEA Wind Task 37 on wind energy systems engineering. The goals of the effort are to create a set of guidelines for a common conceptual architecture for wind turbines and plants so that practitioners can more easily:

- Share descriptions of wind turbines and plants across multiple parties and reduce the Effort for translating descriptions between models,
- Integrate different models together and collaborate on model development, and
- Translate models among different levels of fidelity in the system.

There are many efforts within industry and research communities to integrate wind turbine and plant models into frameworks to support multi-disciplinary design, analysis and optimization activities. The effort here begins with the task of finding a common ontology (hierarchical framework of characteristics) for these types of models to enable more collaboration and integration across the different community stakeholders. This presentation will present work to date including 1) a survey of current frameworks for turbines and plants, 2) a set of matrices for wind system modeling by discipline and fidelity meant to mirror a similar effort from aerospace, CPACS (Rizzo et al 2012), and 3) preliminary ontology development for key wind turbine MDAO applications (rotor aero-structural design). An example of a CPACS-style matrix for the wind turbine rotor is provided in Figure 1.

Wind Turbine Rotor

Fidelity

Hi-fi time resolved turbulence modelled CFD		3D solid				
Blade resolved CFD	Time resolved LES CFD	3D shell				
Actuator Line CFD	Vortex methods	Super-element		Supervisory controllers		
Actuator Disc CFD	DWM	Elemental non-linearity (GEBT)	Generalized 6x6	Safety protection functions		
Vortex methods	Engineering unsteady 3D (Veers/Mann)	Multi-body (linear/non-linear)	Timoshenko	Load mitigation		Full BOM and manufacturing process flow
BEM	Unsteady uniform	Modal	Euler	Power/speed regulation		Empirical design-based
Look-up Table CT&Power	Steady inflow	Rigid	Analytical solid	Prescribed operation	Semi-empirical	Empirical parametric
Rotor aero	**Inflow aero**	**Structures**	**Cross-section structures**	**Controls**	**Acoustics**	**Cost**

Figure 1: Draft Discipline-Fidelity Matrix for the Wind Turbine Rotor; this has been cross-walked against existing MDAO frameworks for wind turbine rotors. The most common fidelities for each discipline are identified and are the starting point for ontology development (i.e. Blade-Element Momentum (BEM) for rotor aerodynamics).

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