Dear Wind Turbine Aerodynamics Modeling Enthusiast,

You are cordially invited to participate in a kick-off meeting of a project to overhaul the AeroDyn aerodynamics software library.

AeroDyn is an aerodynamics software library used in the analysis of horizontal-axis wind turbines. In its present form, AeroDyn calculates the effect of wind turbine wake using the classic quasi-steady blade-element / momentum (BEM) model or the generalized dynamic-wake (GDW) model. The BEM model uses semi-empirical corrections for tip losses, hub losses, and skewed flow, which are effects implicitly included the GDW model solution. In both models, the unsteadiness of the local inflow to an airfoil is accounted for using the semi-empirical Beddoes-Leishman dynamic-stall model. Rotational augmentation of the local 2D airfoil coefficients is accounted for within an external preprocessor using semi-empirical corrections for rotationally induced stall delay. AeroDyn is interfaced to a number of structural dynamic analysis programs (such as YawDyn, SymDyn, FAST, MSC.ADAMS©, and SIMPACK) to enable the coupled aero-elastic analysis of wind turbines.

Based on feedback we have received over the years regarding the functionality and usability of AeroDyn—as well as on our own experiences developing, maintaining, and using the software—NREL has decided to initiate a project in 2008 to do a major overhaul (redevelopment) of the AeroDyn code. (Many of you are aware that we planned to do this overhaul a while back. Other priorities, unfortunately, got in the way and we are just now getting started.) The objectives of the overhaul are to improve its functionality, readability, and usability; to eliminate errors; to make it easier to include additional aerodynamic theories, and to develop a standardized and streamlined interface to structural dynamic analysis programs. The improvement of AeroDyn is important because proper aerodynamic modeling is critical for accurate performance, loads, and stability analyses of wind turbines. The overhaul will be work performed by NREL researchers; however, we would like to incorporate your feedback regarding how the code should be modified and improved. Possible modifications and improvements to AeroDyn include, but are not limited to

- Input and output file format
- Interpolation of airfoil data
- Internal and external coordinate systems
- External preprocessing versus internal calculation of rotational stall delay (rotational augmentation)
- Tower, nacelle, and hub aerodynamic loading, including their influence on the inflow for both downwind and upwind rotors
- Solution algorithms of BEM and GDW
- Numerical integration schemes
- Interaction between the wake models; the tip loss, hub loss, and skewed wake corrections; and the dynamic-stall models
- Aero-elastic interaction
- Influences of high and low frequency wind turbine vibration on the wake
- Tail aerodynamics in furling wind turbines

- Linearization of the wake and dynamic-stall models for controls design and stability analysis
- Modularization of the code so that it is easier to interface new aerodynamic theories, such as additional corrections for tip loss, hub loss, and skewed wake; additional dynamic-stall models; and addition wake theories (such as vortex methods and CFD)
- Development of a "standardized" interface so that the structural dynamic analysis programs that currently use AeroDyn can use different aerodynamic modules and so that AeroDyn can be used by additional structural dynamic analysis programs (such as PHATAS and HAWC2) (a standardized interface would enable one to match aerodynamic model fidelity with the best structural dynamics program for a particular analysis goal)
- Interface in dynamic link library (DLL) versus static library format.

The AeroDyn overhaul kick-off meeting will take place on Wednesday and Thursday, February 13 and 14, 2008 at the National Wind Technology Center (NWTC) [18200 State Hwy 128; Boulder, CO 80303 (USA)]. Local information—including transportation options, lodging recommendations, and security procedures—is available online at http://www.nrel.gov/visiting_nrel/nwtc.html. The meeting will begin at 9:00 a.m. and end at 5:00 p.m. both days. The first day of the meeting will be spent discussing modifications and improvements to the functionality and usability of the code, including aerodynamic theory. The second day will be spent discussing how the interface between AeroDyn and the structural dynamic analysis programs should be standardized. The meeting format will consist of presentations regarding the proposed implementation and restructuring of AeroDyn, followed by discussion. We hope to leave the meeting with a clearer direction on how to proceed with the overhaul.

If you are interested in having an improved wind turbine aerodynamic analysis program and / or developing a standardized aerodynamics module interface, please come! **We ask that you kindly RSVP with your intention to participate to Jason Jonkman by Friday, February 1, 2008.** If you would like to share a presentation regarding particular opinions about any one of the code modifications, please let us know in your RSVP. Let us know if you have any questions.

We look forward to seeing you in Colorado in February!

Best regards,

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