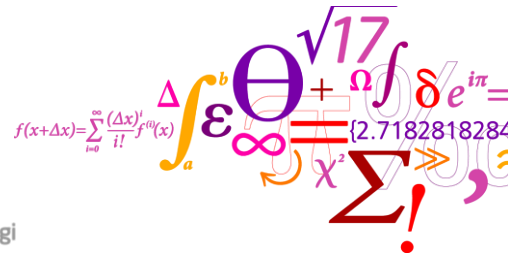




HAWC2 course 15-17th of April

Anders Yde (AY)
 Torben J. Larsen (TJ)
 Lars Christian Henriksen (LC)
 Knud Abildgaard Kragh (KA)
 Anders Melchior Hansen (AM)



Risø DTU
 Nationallaboratoriet for Bæredygtig Energi



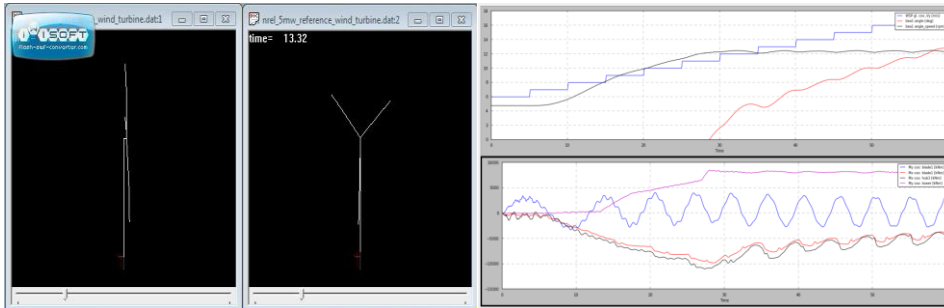
Time Schedule

	Morning	Afternoon
Monday, 15/4	<ul style="list-style-type: none"> • Introduction (AY,TJ) • Structural modeling and implementation in HAWC2 (AY) 	<ul style="list-style-type: none"> • Wind condition, modeling and implementation in HAWC2 (TJ) • Aerodynamic modeling and implementation in HAWC2 (TJ)
Tuesday, 16/4	<ul style="list-style-type: none"> • Controller implementation and tuning (LC) • HAWCstab2 (LC) • IEC Load cases (KA) • Autogeneration of inputfiles (KA) 	<ul style="list-style-type: none"> • Hydrodynamics and wave kinematics module (TJ) • Floating structures, mooring lines and external system (AM)
Wednesday, 17/4	<ul style="list-style-type: none"> • Wake loads (TJ) • Soil module (AY) 	<ul style="list-style-type: none"> • Extreme & fatigue loads (TJ) • Post processing tools (AY) • VAWT in hawc2 (TJ)



What is the HAWC2 code?

A tool for simulation of wind turbine response in time domain



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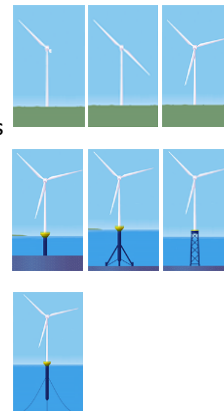
Anders Yde



What is the HAWC2 code?

General applicatoin

- Normal onshore with 1 or multiple blades
- Pitch and (active) stall controlled wind turbines
- Guyed support structures
- Offshore turbines on monopoles, tripods or jackets
- Floating turbines with mooring lines
- Multiple rotors in one simulation



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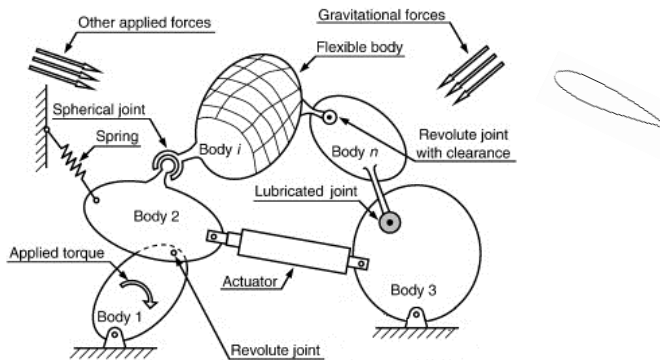
Anders Yde



What is the HAWC2 code?

Structural core based on multibody formulation with a floating frame of reference.

- Can handle multiple degrees of freedom (like blade torsion)



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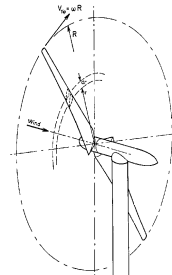
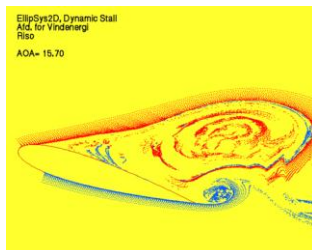
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What is the HAWC2 code?

Detailed aerodynamic model based on BEM that includes:

- Three dynamic stall models: Stig Øye model, a modified Beddoes-leishmann model and model for ATEF (Active Trailing Edge Flaps)
- Skew inflow model
- Shear effects on the induction
- Dynamic inflow model
- Tiploss



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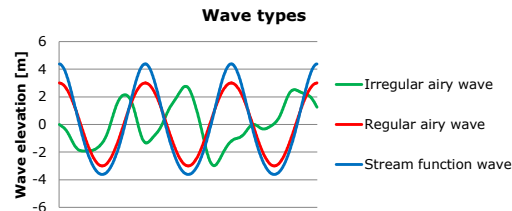
Præsentationens titel 13-aug-2008



What is the HAWC2 code?

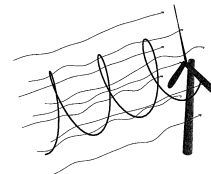
Hydrodynamic model based on Morrison's equation

- Water Kinematics that includes:
 - Currents
 - Linear airy waves
 - Irregular airy waves
 - Deterministic irregular waves
 - Stream function waves



Wind, turbulence and wake models

- Build-in Mann turbulence generator (Fully coherent 3D-turbulence)
- Able to read Veers turbulence model (used in FLEX5)
- Dynamic wake meandering model for turbines in wakes



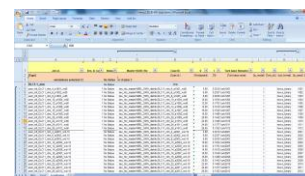
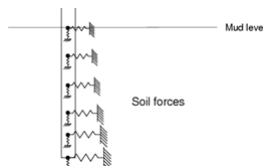
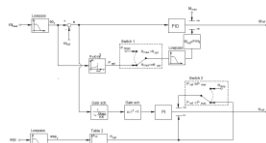
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What is the HAWC2 code?

- Control interface preformed through DLL's (Dynamic Link Library)
 - Default controller provided with a pitchregulated variable speed controller
- Soil module consisting of a set of spring-damper forces attached to a main body.
- Excel spreadsheet macros for automatic input file creation – coupled to a distributed computing tool.
- Time domain simulations is the primary output, however eigenvalues can be calculated at stand still.



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Program structure

Name	Date modified	Type	Size
animation	30-09-2011 08:20	File folder	
control	30-09-2011 08:20	File folder	
data	30-09-2011 08:20	File folder	
eigenfrq	25-08-2011 11:22	File folder	
htc	30-09-2011 08:20	File folder	
log	30-09-2011 08:20	File folder	
res	30-09-2011 08:20	File folder	
turb	30-09-2011 08:20	File folder	
manual_version_4-0.pdf	12-07-2011 12:39	Adobe Acrobat D...	1.053 KB
Animation.exe	21-09-2008 09:54	Application	1.825 KB
get_mac_adresses.exe	27-09-2010 11:01	Application	364 KB
hawc2MB.exe	17-05-2011 10:52	Application	3.244 KB
WINDAP.exe	16-11-2006 16:03	Application	1.208 KB
ainslie_15.dll	04-12-2009 23:47	DLL File	32 KB
DFORMD.DLL	20-06-2001 03:11	DLL File	448 KB
DFORMDD.DLL	20-06-2001 03:11	DLL File	448 KB
DFORRT.DLL	20-06-2001 03:10	DLL File	440 KB
DFORRTD.DLL	20-06-2001 03:10	DLL File	440 KB
licence_manager.dll	27-09-2010 11:18	DLL File	424 KB
Mann.dll	10-06-2009 15:30	DLL File	97 KB
MSVCRTD.DLL	07-03-2000 00:00	DLL File	425 KB
wkin_dll.dll	07-05-2009 14:48	DLL File	144 KB
Hawc2Bat.BAT	07-04-2011 13:57	Windows Batch File	1 KB
start_dos.bat	30-09-2010 17:39	Windows Batch File	1 KB

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License manager

- When properly installed the HAWC2 answer to execution should be like this:

```

C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600.1]
(C) Copyright 1985-2001 Microsoft Corp.

c:\Risoe\Undervisning\HAWC2_course_2009\hawc2_model>hawc2MB.exe
HAWC2MB version: HAWC2MB 8.2
License verified - OK
Wrong number of arguments: Usage: <exe file> <htc file>
c:\Risoe\Undervisning\HAWC2_course_2009\hawc2_model>

```

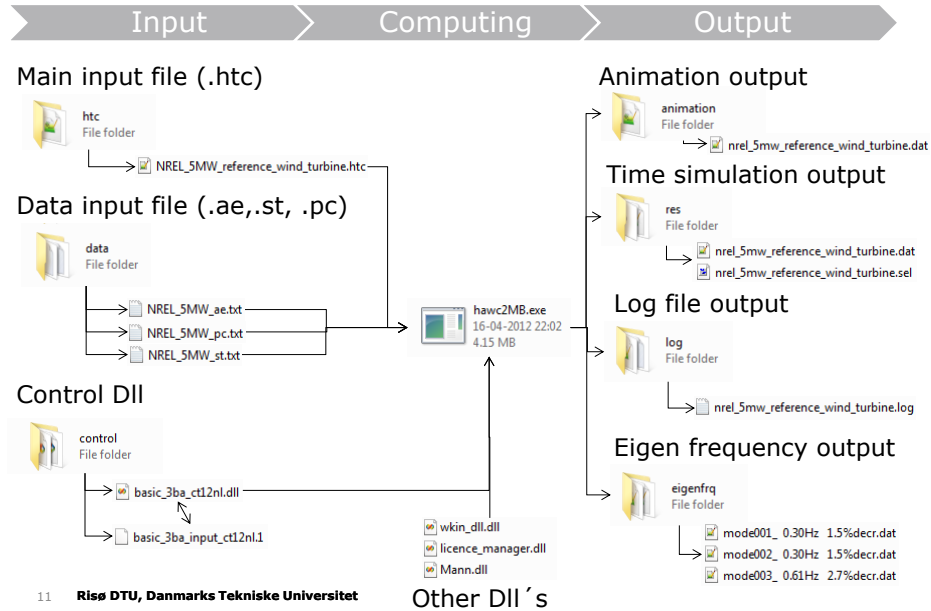
- To start HAWC2:

- 1) start dos prompt  in the main folder
- 2) write "hawc2mb"

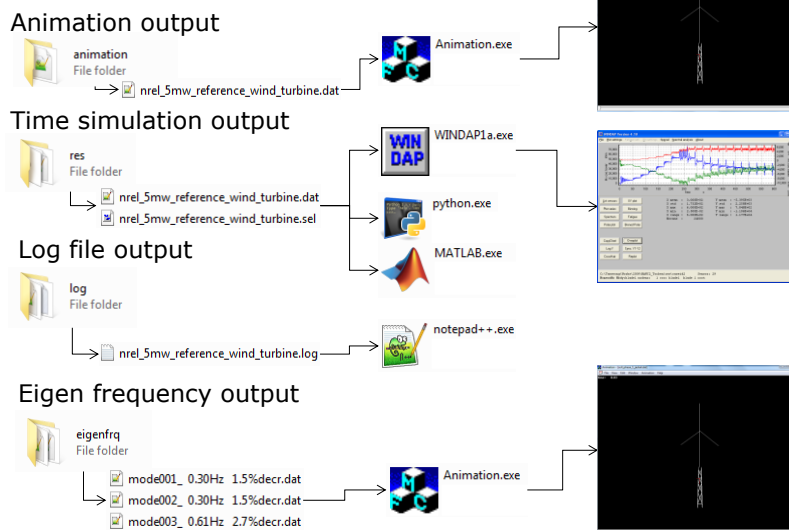
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Anders Yde 03-oct-2011

Program structure



Postprocessing





Working with text based input

Use a editor with useful features:

e.g. notepad ++

Main folder -> tools -> Notepad++6.2-> npp.6.2.Installer.exe

Install hawc2 language for notepad ++:

- Get a better overview of your input file
- Main folder -> tools -> HAWC2 language for Notepad++ -> follow instructions

Intall plugins for notepad ++:

- Useful tool like compare and monitor documents
- Main folder -> tools -> Plugins for Notepad++ -> follow instructions

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License manager

- When properly installed the HAWC2 answer to execution should be like this:

```

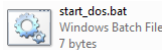
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
Copyright 1985-2001 Microsoft Corp.

c:\Risoe\Undervisning\HAWC2_course_2009\hawc2_model>hawc2MB.exe
HAWC2MB version: HAWC2MB 8.2
License verified - OK
Wrong number of arguments: Usage: <exe file> <htc file>
c:\Risoe\Undervisning\HAWC2_course_2009\hawc2_model>

```

- To start HAWC2:

- 1) start dos prompt
- 2) write "hawc2mb"



in the main folder

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Anders Yde 03-oct-2011