SPCE: Sound Propagation Comparison Exercise

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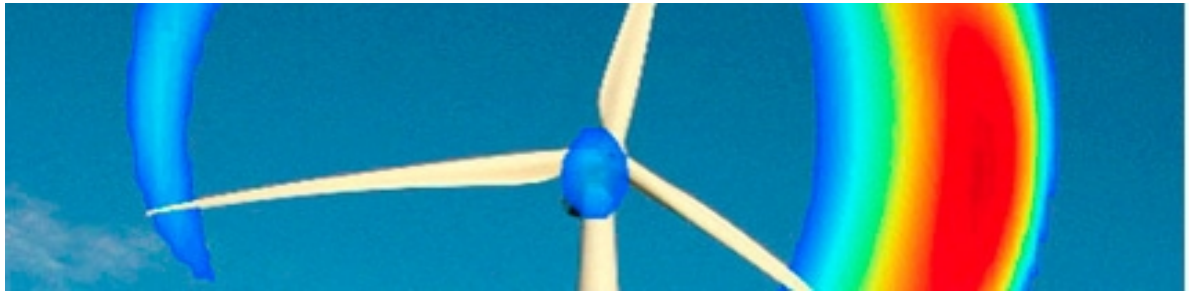
Publication date:
2014

SPCE: Sound Propagation Comparison Exercise

Wind Turbine Sound 2014 Organizing Committee



EWEA Technology Workshop:
Wind Turbine Sound 2014
9-10 December 2014
Malmö, Sweden

Comparison Exercise

- **EWEA organized previous comparison exercises**
  - **2011 CREYAP Part I**
  - **2013 CREYAP Part II**
  - **2013 Offshore CREYAP Part I**

    http://www.ewea.org/comparison-exercises/

- **Idea: Perform similar exercise for**

  wind turbine sound propagation

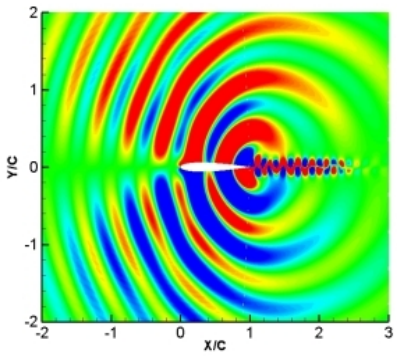
  - **Sound Propagation Comparison Exercise**

    = SPCE

WIND TURBINE NOISE

Noise generation mechanisms

Aerodynamic and/or Mechanical noise

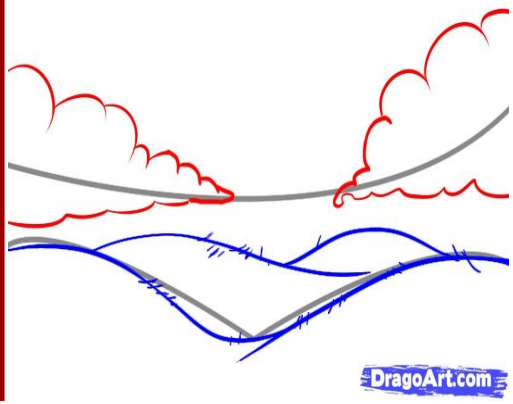


Wind turbine noise

As it can be measured in the direct vicinity of the wind turbine & As used for WT noise assessment

Propagation of sound

Atmospheric conditions, Orography, Vegetation, Refraction, Diffraction



Perception of sound by receiver

More subjective, Sensitivity of individual, Quality of noise, Home insulation

The Physics of Sound Propagation

Influenced by:

- **Atmospheric conditions**
  - *Stratification*
  - *Wind direction*
  - *Wind shear/veer*
  - *Turbulence*
- **Boundary conditions**
  - *Topography*
  - *Vegetation / Water*
  - *Man-made structures*
- **Sound intrinsic properties**
  - *Different frequencies travel differently*
  - *AM*

… make predictions difficult!!!

Prediction Methods

From very simple to advanced:

- **Analytic formula**
  - *Attenuation as fct. of distance*
  - ...
- **Simplified physics**
  - *Ray method*
  - *Vegetation / Water*
  - *Man-made structures*
- **Partial differential eqns.**
  - *Parabolic eqns. method*
  - *CAA*

Different hypotheses *and implementations* may yield *very different results!*

Prediction Methods Results

Sensivity of the results to:

- **Local wind turbine site conditions**
- **Model accuracy**
- **Various standards/norms for *quantifying noise immission levels***
- **User itself!!!**
  - Experience
  - Interpretation of the local site conditions
  - Interpretation of the noise sources (corrections/uncertainties)
  - Interpretation of the results (post-calculation corrections)

Comparison Exercise Ojectives

- **Evaluate influence of above parameters**
- **Not a parameter study!**
  - → **Rather study influence of parameters relatively to the different methods**
- **Evaluate models with respect to each other**
- **How same type of models can differ**
- **How different users may yield different results**
- **Final goal:**
  - → **Provide *guidelines/regulations* for using sound propagation prediction methods**

Comparison Exercise: Test Cases

- **Inputs (provided as test cases definition)**
  - 1 landscape with different features in 4 cardinal directions:
    - Flat/hilly
    - Surface cover
    - Sheltered/non-sheltered houses
  - For different atmospheric conditions (?)
  - For different wind speeds & directions
  - Turbine sound data:
    - Location and hub height
    - Overall sound levels and/or 1/3 oct. band spectra
    - Uncertainty
    - AM – Effect of AM at source on far-field noise (?)

Comparison Exercise: Test Cases

- **Outputs (returned by the participants)**
  - Noise Levels (L_{eq}, L_{90}, spectra…)
  - At specified locations ranging from 300 to 2000m
  - At specified heights
  - → **Using provided template for the results**
    Easier post-processing and analysis of the "many" participants data!

- **Participants also to provide - Survey form:**
  - Organisation name and person responsible
  - Details on noise propagation model
  - Use of post-calculation corrections (if so, why?)
  - Participants welcome to use different prediction methods/models and explain differences

Comparison Exercise: Procedure

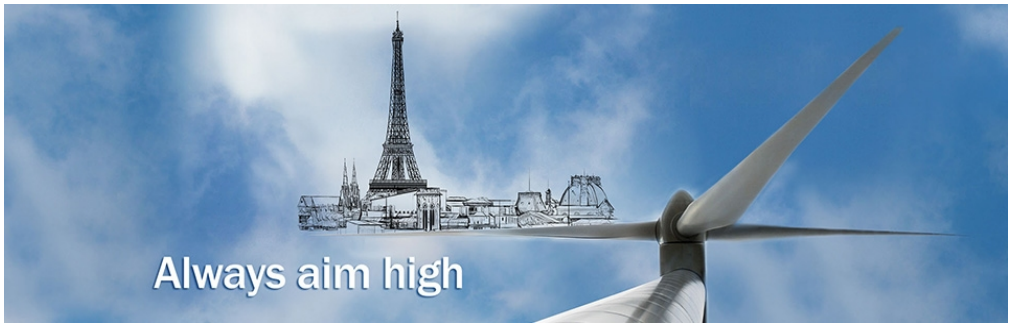
- **Participants perform calculations and send back results template and survey form**
  - Results in pre-defined template
  - Description of method used, in-house or commercial code, user details
- **EWEA representative collects all data**
  - Data made anonymous
- **DTU Wind Energy performs data analysis**
  - Provide a report compiling results and conclusions
  - Presentation at a later EWEA event

Comparison Exercise: Timeline

- **Call to participant (~ February/March)**
  - Test-cases definition and result templates sent to those interested in participating
  - http://www.ewea.org/comparison-exercises/

- **Deadline for participants returning results template & survey (~ August/September)**

- **Presentation of the results analysis at EWEA 2015 Annual Event , Paris 17/20 November 2015**



Discussion…

- What is your opinion on this exercise?
- Suggestions concerning the test-cases…
- Suggestions concerning the procedure…