Master's Dissertation at the Div. of Engineering Acoustics

SOUND PROPAGATION OF WIND TURBINES IN FOREST AREAS

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Purpose of thesis

- Provide an increased understanding of the effects of placing wind turbines in forest areas with regards to turbine sound propagation.

- Investigate the methods currently used to estimate the sound propagation and immission in forests as well as argue their suitability in the Australian bush land.

- Develop a modified calculation model of sound propagation that is particularly compatible with the vegetation of Australian forests (in certain areas of interest).
Ultimately a sound propagation model will be composed, which can predict the sound propagation of the bush lands in Australia.

Method

- Literature study of the basics of sound emission and immission, in general and in reference to forest areas. Subject areas of interest include:

  – Sound emission and immission (in general and from wind turbines)
  – Sound propagation
  – Sound propagation variables
  E.g. source (turbine) geometry, meteorological conditions (temperature, humidity and wind speed/direction), speed of sound, atmospheric absorption, terrain type and contour (ground absorption, reflections) and obstructions (buildings, barriers and vegetation).
  – Sound effect (reflected and absorbed)
  – Noise health effects (in general and in reference to wind turbines)
  – Wind turbine noise as a part of Environ mental Impact Assessment (IEA)
  – And more.

Furthermore a study of the composition of Australian bush vegetation (and terrain) will be conducted, especially in areas of interest for future wind turbine plants by GE.
The standards and calculation models that are currently being used by GE will also be examined and a theory of their suitability in the bush lands of Australia will be formulated.

- Measurements of the absorption ability of components in the Australian forests will be performed, using a so called Kundt-tube (impedance tube) and/or other measuring instruments with similar or complementary properties. The results of the measurements will be compiled and an absorption coefficient corresponding to the specific vegetation of Australian forests will be attained.
Furthermore, measurements of sound pressure and reverberation time will be performed in a forested area of interest. The measurements will be executed three times per day over approximately three days. In addition, the air temperature will be recorded during all measuring periods. The measurements will be performed in a selected area of the forest and the diameter of all trees within this areas will be measure, hence the surface area may be roughly calculated.
The results of the reverberation time will give an indication of the vegetation absorption, which can be compared with certain values of absorption attained previously. The values of temperature will be used to calculate the acoustic impedance for the area.
Other factors that contribute to the sound propagation in forests (e.g. ground conditions and air humidity) may also be taken into consideration.

- Finally a propagation model will be constructed, consisting of input values of temperature versus frequency and output values of the product of determined absorption coefficient and acoustic impedance. The model will enable predictions of the sound propagation in these areas.

- If time and knowledge allows, a calculation model determining the propagation for any bush land in Australia will be developed using Matlab or Excel.

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