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Sodar acoustic enclosure versus ambient acoustic noise, ground clutter and aerodynamically generated wind noise

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1 Short abstract

Some commercial “mini” sodars (sound detection and ranging for remote wind speed measurement) can now be considered for wind energy siting, especially for large wind mills operation.

However, “mini” infers that such sodars should be reasonably small in order to allow easy transport, setup and dismantling.

At the same time, they must allow measurement of high wind speeds although such winds generate acoustic noise which reduces sodar efficiency.

We discuss about an acceptable compromise both from the acoustic and wind protection efficiency of a portable screen. This discussion includes 3D numerical modeling and on site experimental data.

2 Extended abstract

Recently at least two “mini” sodars have shown their ability to measure accurately wind speed and direction to such a point that they appear a good choice for wind energy siting especially for very tall wind mills.

However, the very significant difference in size of the screens (over a factor of 100 in volume) used during the experiment suggests that some optimization work needs to be performed. The ultimate goal being to cover the required wind speed range (typically up to 20 m/s at mid propeller level) and still come up with an easily transportable sodar allowing quick setup and dismantling.

An acoustic screen must also be efficient from the point of view of minimizing the level of so called acoustic secondary lobes. This allows a better measurement precision, reduces the impact of ground clutter and keeps to its minimum the acoustic nuisance of the system.

Reducing the effect of strong winds which generate acoustic noise and make the backscattered waves less coherent (because of turbulence) - both effects resulting in degraded sodar operation – is an obvious improvement.

This paper describes first the purely acoustic optimization through the use of a sophisticated three dimensional acoustic numerical model. Its resolution allows a realistic modelisation of each individual transducer, an accurate representation of the acoustic foam lining the inside of the acoustic screens and to some extent describes the " ringing" phenomena which are so important for reducing the starting altitude range of a sodar. This numerical model was initially developped on contract from the French Navy.

Regarding the wind generated acoustic noise we then discuss the effect of edges characteristic dimensions and shapes as well as designing the overall shape and size of the hood in order to stabilize the flow close to the antenna. This is very important as a turbulent flow generates phase and amplitude variations across the phased array antenna, thus reducing its efficiency.

Finally, as illustration of these issues, we show different experimental results with different screens which allow to come up with a good compromise both from the point of view of wind energy siting requirements and of real transportability as well as quick and easy setup and dismantling of the sodar equipment.