

## Scope

While wind energy industry growing rapidly and siting of wind turbines onshore as well as offshore is increasing, many wind engineering model tools have been developed for the assessment of loads on wind turbines due to varying wind speeds.

In order to have proper wind turbine design and performance analysis, it is important to have an accurate representation of the incoming wind field. To ease the analysis, tools for the

generation of synthetic wind fields have been developed, e.g the widely used TurbSim procedure [1].

We analyse measured sets and the respective synthetic data sets in view of the similarity of the spectral characteristics and the statistics of wind speed increments (relevance to load assessment) of measured and synthetic sets

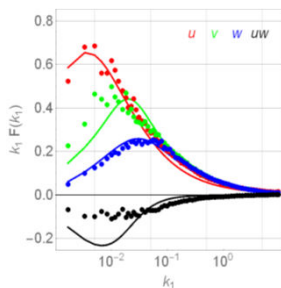
Measured data are from the server of the NREL Wind turbine test center.



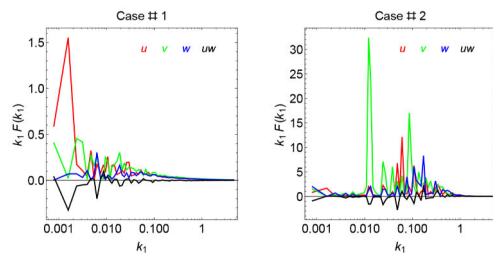
NREL National wind technology test center (picture taken from: [http://www.nrel.gov/wind/facilities\\_test\\_pads.html](http://www.nrel.gov/wind/facilities_test_pads.html))

## Spectra and increment statistics of measured and synthetic sets

### Spectra



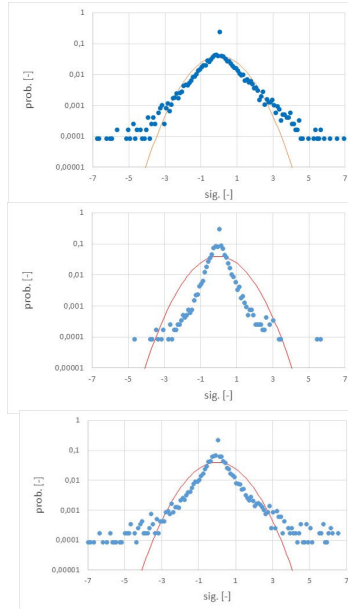
The Mann model spectra (lines) fitted with the observed spectra (dots) at  $z=100$  m from NREL's met-mast for mean wind speed of 13.5 m/s [1].



Spectra from synthetic data are generated by NREL's Model (NWTcup) without (case 1) and with (case 2) function "KHTEST" which superimposes a coherent event in the output time series [3].

Distribution of increments in the  $u$  component of measured 20Hz data (height 100m)

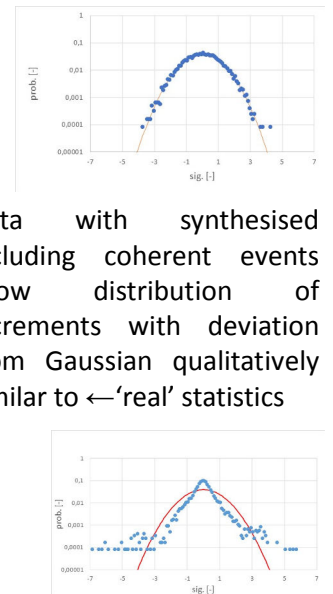
Increments normalized by standard deviation of set (Gaussian dist. (red).



Non gaussian distributions signal intermitten characteristics. Details to be analyzed.

Increments in synthetic sets (20 Hz)

Data without superimposed coherent events (pure fourier synthesis) present Gaussian characteristics



Data with synthesised including coherent events show distribution of increments with deviation from Gaussian qualitatively similar to ← 'real' statistics

Tuning to empirical distributions to be developed.

## Conclusions

Available tools for data synthesis prove to be able for the qualitative reflection of non gaussian properties of wind speed increments. Further analysis is necessary for both parametrisation of those properties and respective adaption of the tools.

This work is part of the Norwegian NORCOWE project



## References

- [1] Nwtc information portal (turbSim) <https://nwtc.nrel.gov/turbSim> accessed 25-February-2016
- [2] Chougule AG et al., 2012 J. Turbul. 13(36) 1–13
- [3] Jonkman B J and Kilcher L 2012 TurbSim user's guide: Version 1.06.00 Technical Report NREL/TP-xxx-xxxx National Renewable Energy Laboratory