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Individual pitch control for wind turbine load reduction recognizing atmospheric stability

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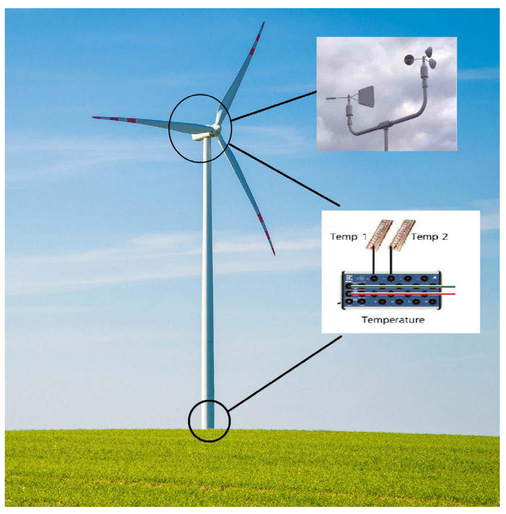
Abstract

This poster presents the methodology for determining the optimal values of pitch angles considering the possibility of individual pitch control (IPC) in order to reduce stress on the wind turbines blades. Unlike previous studies, this methodology aims to determine the reference values of the pitch angles in different atmospheric stability conditions, which directly affect the vertical wind speed profile. The stability of the atmosphere is determined by measuring the air temperature at two different heights, on the basis of which further estimation of vertical wind speed profile is conducted. The results show the reference pitch angles for the same wind speed at turbine hub and different vertical wind speed profile caused by different atmospheric stability.

Estimation of atmospheric stability



v=15m/s

t_1, t_2

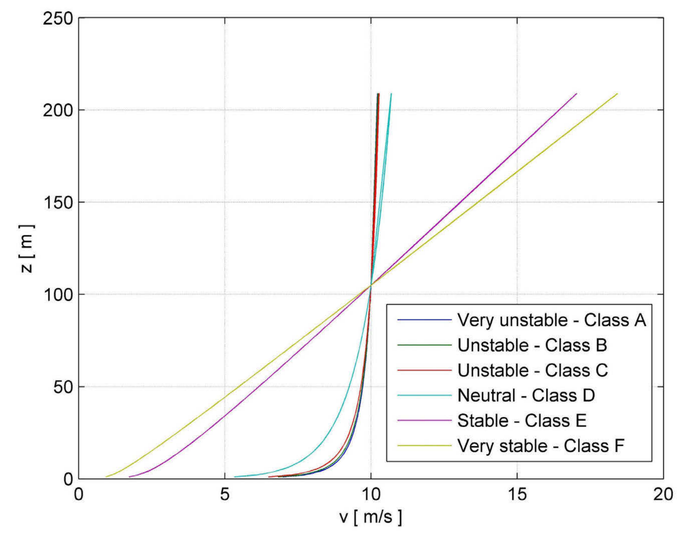
z_1, z_2

Estimation of vertical wind speed profile

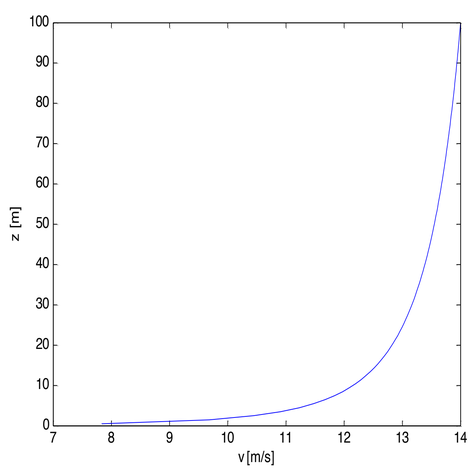
Determination of:

- Vertical temperature gradient
- Pasquill stability class
- Parameter of atmospheric stability – ψ_m

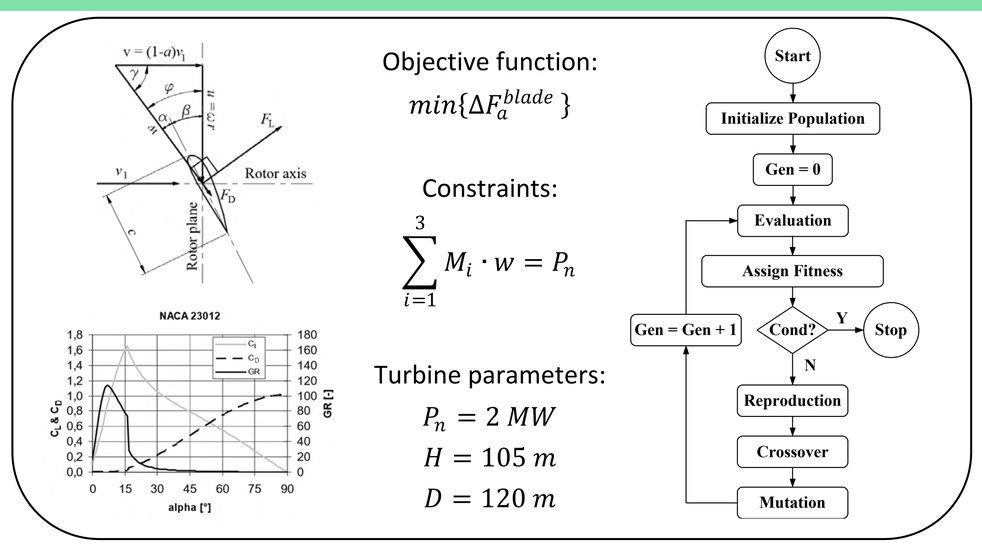
$$v_2 = v_1 \cdot \frac{\ln\left(\frac{z_2}{z_0}\right) - \psi_m}{\ln\left(\frac{z_1}{z_0}\right) - \psi_m}$$



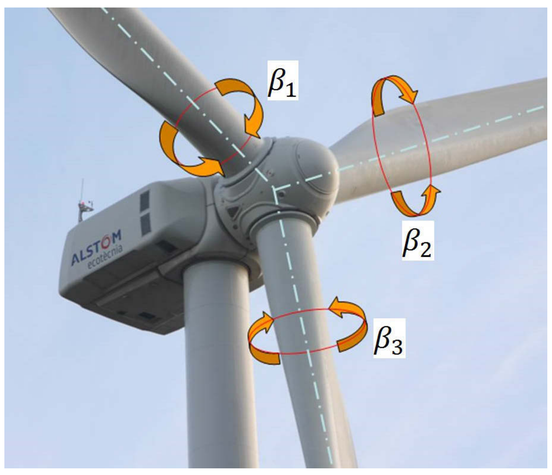
Methodology



Vertical wind profile

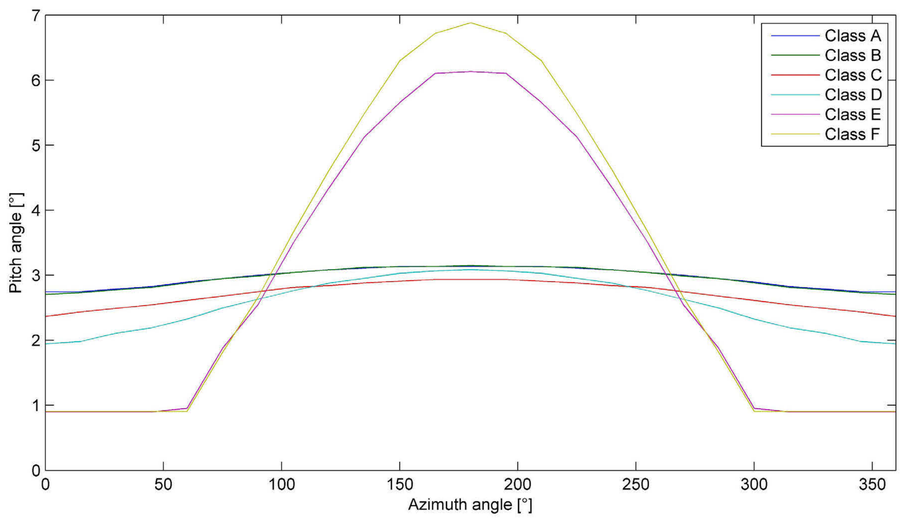


Metodology

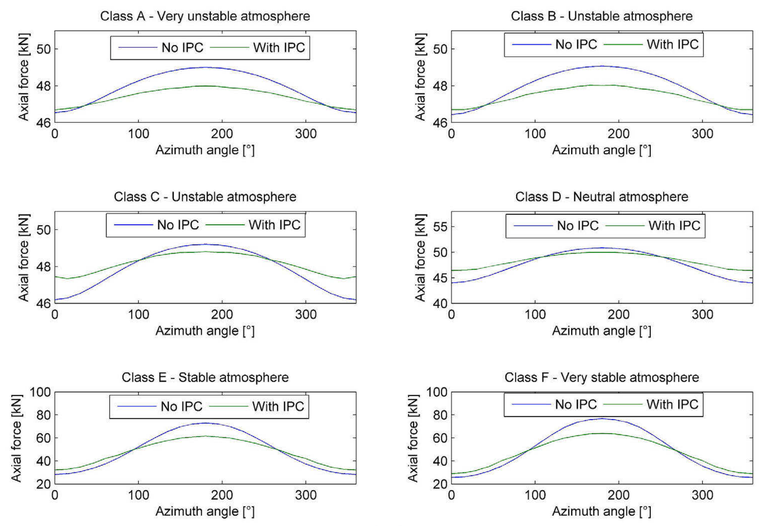


Optimal pitch angles

Results



Optimal pitch angles



Axial forces

Conclusions

In this paper, a methodology for determining the optimum pitch angle of the wind turbine blades in conditions of different atmospheric stability in order to reduce the load on the turbine has been developed. The proposed algorithm is capable to estimate atmospheric stability and vertical wind speed profile based on measured wind speed at the turbine hub and temperature gradient, and then, considering those information to implement individual pitch control in order to minimize the load on the turbine, without changing the average turbine output power. Results obtained from simulations confirm all the advantages of the proposed algorithm.

References

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5. http://usuaris.tinet.cat/zefir/pitch.htm