The Numerical Analysis of Power Efficiency and Aerodynamic Loading in Small Wind Turbine Rotors

張剛耀、羅正忠

E-mail: 9509792@mail.dyu.edu.tw

ABSTRACT

The purpose of this project is to analyze aerodynamic loading and power efficiency of small wind turbine rotors using numerical method. The mathematic model of aerodynamics of wind turbine rotor in quasi-state is developed based on disk theory, the momentum theory, angular momentum theory and blade element momentum theory. The strip theory is utilized to perform the numerical analysis of mathematic rotor model. The numerical prediction of axial forces, hub moments, torques and pitching moments related to blade positions are reported in this study. The influence of wind velocity and rotational frequency on aerodynamic loadings and power efficiency of rotor is investigated and reported in this research. The conclusions and suggestions are addressed in the end of this report.

Keywords : Aerodynamic loading in Wind Turbine， The Numerical Analysis of Power Efficiency， Aerodynamic

Table of Contents

REFERENCES

[1] 賴耿陽, “ 小型風車設計及製造, ” 復漢出版社,(2001) [2] http://www.poullacour.dk/dansk/museet.htm [3] http://www.ewea.org [4] 林敬淵、鄭榮和, “ 被動式可變節距角風力機葉片設計分析, ” 中國機械工程學會第二十屆 全國學術研討會,國立台灣大學,2003年。

[5] 翁榮羨、李欣哲, “ 風能轉換與風力發電技術, ” 電工通訊,民國九十年。

[6] “ 新能源及潔淨能源研究開發規總報告, ” 能源會,民國八十八年 [7] Lanchester FW. Contribution to the theory of propulsion and the screw propeller. Transactions of the Institution of Naval Architects; LVII: 98 – 116. 1915 [8] Glauert H. Aerodynamic theory, vol. 4. Berlin, Germany:Julius Springer. p. 169 – 360 (Chapter Division L). 1935 [9] van Kuik G. 25 years of wind turbine technology development. In: Watson R, editor. European Wind Energy Conference 1997, IWEA, Slane, Ireland,p. 21 – 4 , 1997 [10] Snel H , Review of the present status of rotor aerodynamics, Wind Energy p46 – 69.1998 [11] Leishman JG. , Challenges in modelling the unsteady aerodynamics of wind turbines , Wind Energy p85 – 132,2002 [12] Kotb MA, Schetz JA. Wind turbine blade mean and turbulent flowfield measurements , European Wind Energy Association Conference, p387 – 90,1986 [13] J. F. Manwell, J. G. McGowan and A. L. Rogers, Wind Energy Explained – Theory, Design and Application, John Wiley & Sons Ltd, 2002.

[14] Tony Burton, David Sharpe, Nick Jenkins, Ervin Bossanyi, Wind Energy Handbook, John Wiley & Sons Ltd, 2001.