

## Optimal Design of Wind Turbine Blades Equipped with Flaps

**Authors :** I. Kade Wiratama

**Abstract :** As a result of the significant growth of wind turbines in size, blade load control has become the main challenge for large wind turbines. Many advanced techniques have been investigated aiming at developing control devices to ease blade loading. Amongst them, trailing edge flaps have been proven as effective devices for load alleviation. The present study aims at investigating the potential benefits of flaps in enhancing the energy capture capabilities rather than blade load alleviation. A software tool is especially developed for the aerodynamic simulation of wind turbines utilising blades equipped with flaps. As part of the aerodynamic simulation of these wind turbines, the control system must be also simulated. The simulation of the control system is carried out via solving an optimisation problem which gives the best value for the controlling parameter at each wind turbine run condition. Developing a genetic algorithm optimisation tool which is especially designed for wind turbine blades and integrating it with the aerodynamic performance evaluator, a design optimisation tool for blades equipped with flaps is constructed. The design optimisation tool is employed to carry out design case studies. The results of design case studies on wind turbine AWT 27 reveal that, as expected, the location of flap is a key parameter influencing the amount of improvement in the power extraction. The best location for placing a flap is at about 70% of the blade span from the root of the blade. The size of the flap has also significant effect on the amount of enhancement in the average power. This effect, however, reduces dramatically as the size increases. For constant speed rotors, adding flaps without re-designing the topology of the blade can improve the power extraction capability as high as of about 5%. However, with re-designing the blade pretwist the overall improvement can be reached as high as 12%.

**Keywords :** flaps, design blade, optimisation, simulation, genetic algorithm, WTAero

**Conference Title :** ICREE 2014 : International Conference on Renewable Energy and Environment

**Conference Location :** Bali, Indonesia

**Conference Dates :** October 09-10, 2014