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DARRIEUS ROTOR SPEED STABILIZATION BY JOINT VARIATION OF THE BLADE AND THE TRAVERSE LENGTH

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With the ever-increasing prices of and demand for traditional fuels and the decreasing availability thereof, renewable energy sources, such as wind energy, are gaining enormous popularity. First of all, this branch of "green" energy is environmentally friendly. A significant increase in the use of wind power plants (WPPs) is observed all over the world. Modern WPPs are of two types: vertical- and horizontal-axis ones. Vertical-axis WPPs, in contrast to horizontal-axis ones, have a number of specific design advantages, such as, for example, insensitivity to the wind direction, which significantly simplify their design and increase their reliability. The operation of vertical-axis WPPs involves the need to stabilize their operating regimes, the main objective of which is to stabilize electricity production in conditions of a variable wind speed using appropriate stabilization systems (SSs). In SS development, use is made of various control algorithms, which make a basis for harnessing physical principles of SS construction. Recently, SSs based on blade swept area variation have become widespread. Such systems, unlike systems based on, for example, generator load variation, actually use the adaptation of WPPs to a variable wind speed, and they dispense with the need for mechanical dissipation of excess energy by resistance forces and, to some extent, with the need to transfer it to the support. The last point significantly reduces the load on the rotor-to-generator transmission systems and alleviates the requirements for anchor systems in the case of WPPs installed on floating platforms. In terms of design, the stabilization of vertical-axis WPPs by swept area variation can be performed in three ways: by varying the blade length, varying the length of the traverses whereby the blades are attached to the rotor shaft, and by simultaneously varying the length of the blades and the traverses, i.e., by varying WPP rotor configuration. The elaboration of approaches to the development of algorithms for the stabilization of vertical-axis WPPs controlled by rotor configuration variation is an important and promising task. The goal of this paper is to develop efficient algorithms for stabilizing the variable-configuration WPP rotor speed providing the stability and operability of the channels of blade and traverse length variation in their simultaneous operation. The problem is solved using methods of the classical theory of automatic control and mathematical simulation. The novelty lies in extending the concept of control by swept area variation to Darrieus vertical-axis WPPs, synthesizing efficient algorithms for stabilizing the rotor speed of Darrieus vertical-axis WPPs controlled by rotor configuration variation, and determining conditions for their stability and operability. The algorithms and approach developed may be used in substantiating design solutions for Darrieus vertical-axis WPPs.

Keywords: *wind power plants, Darrieus rotor, rotary speed stabilization, stability, operability, mathematical simulation.*

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