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(54) **NONLINEAR POWER FLOW FEEDBACK CONTROL FOR IMPROVED STABILITY AND PERFORMANCE OF AIRFOIL SECTIONS**

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(52) **U.S. Cl.**
USPC **703/9**; 703/1; 703/2; 703/7; 416/36

(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

A computer-implemented method of determining the pitch stability of an airfoil system, comprising using a computer to numerically integrate a differential equation of motion that includes terms describing PID controller action. In one model, the differential equation characterizes the time-dependent response of the airfoil's pitch angle, α. The computer model calculates limit-cycles of the model, which represent the stability boundaries of the airfoil system. Once the stability boundary is known, feedback control can be implemented, by using, for example, a PID controller to control a feedback actuator. The method allows the PID controller gain constants, K_I, K_p, and K_d, to be optimized. This permits operation closer to the stability boundaries, while preventing the physical apparatus from unintentionally crossing the stability boundaries. Operating closer to the stability boundaries permits greater power efficiencies to be extracted from the airfoil system.

17 Claims, 17 Drawing Sheets