PID Controller Based on Bird Mating Optimizer for Vibration Cancellation of Horizontal Flexible Plate

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Abstract The flexible system has massive benefits compared to the rigid structure, which is lightweight, low energy consumption and high efficiency. However, the lightweight structure causes undesired vibrations on a system that could damage the structure. This paper proposes a modelling of horizontal flexible plate structure by utilizing bird mating optimizer algorithm and implementation of vibration control on the system in simulation environment. There are two main objectives of this project which are to model a horizontal flexible plate system and to design an accurate controller by eliminating the excessive vibration of the system in order to achieve high-performance efficiency. Initially, input–output experiment data is collected from previous researchers and utilized to model system development. Then, the linear autoregressive with exogenous (ARX) model is selected as a model structure for model development using system identification method via bird mating optimizer (BMO) algorithm. Thereafter, the developed models were evaluated by mean square error (MSE), correlation tests and pole-zero map. The finest model is identified based on the minimum MSE, stable in a pole-zero diagram and unbiased in correlation tests. Then, the mathematical transfer function of the best model is utilized for the development of the PID controller. The controller parameter is tuned using trial and error method. Finally, the developed controller was evaluated and accessed using two different disturbances known as single and multiple sinusoidal disturbances. The result shows a significant vibration reduction of 11.18 and 10.13% for single and multiple sinusoidal disturbances, respectively.

Keywords Flexible plate structure · System identification · Swarm intelligence algorithm · Bird mating optimizer · Active vibration control

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