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Time-Domain Expressions for Bridge Self-Excited Aerodynamic Forces by Modified Particle Swarm Optimizer

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Abstract : This study introduces the theory of modified particle swarm optimizer and its application in time-domain expressions for bridge self-excited aerodynamic forces. Based on the indicial function expression and the rational function expression in time-domain expression for bridge self-excited aerodynamic forces, the characteristics of the two methods, i.e. the modified particle swarm optimizer and conventional search method, are compared in flutter derivatives' fitting process. Theoretical analysis and numerical results indicate that adopting whether the indicial function expression or the rational function expression, the fitting flutter derivatives obtained by modified particle swarm optimizer have better goodness of fit with ones obtained from experiment. As to the flutter derivatives which have higher nonlinearity, the self-excited aerodynamic forces, using the flutter derivatives obtained through modified particle swarm optimizer fitting process, are much closer to the ones simulated by the experimental. The modified particle swarm optimizer was used to recognize the parameters of time-domain expressions for flutter derivatives of an actual long-span highway-railway truss bridge with double decks at the wind attack angle of 0°, -3° and +3°. It was found that this method could solve the bounded problems of attenuation coefficient effectively in conventional search method, and had the ability of searching in unboundedly area. Accordingly, this study provides a method for engineering industry to frequently and efficiently obtain the time-domain expressions for bridge self-excited aerodynamic forces.

Keywords : time-domain expressions, bridge self-excited aerodynamic forces, modified particle swarm optimizer, long-span highway-railway truss bridge
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