Research On Optimal Sensor Placement Of Plane Tensile Membrane Structure Based On Particle Swarm Optimization Algorithm

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Currently, the optimal sensor placement of cable membrane structure is still basically judged by experience, which can't ensure the accurate collection of structural service state information. In view of the above problems, this paper takes the plane bidirectional tensile membrane structure as an example and studies the optimal sensor layout based on the effective independence method, QR decomposition method and particle swarm optimization algorithm. Firstly, the numerical simulation model is established by combining 3D3S and ANSYS software. Based on the Fisher information matrix2-norm method, the number of target modes of plane tensile membrane structure is selected. The main contribution modes of the structure are selected according to the size of structural modal strain energy, and then the monitoring mode order is determined. Secondly, the initial measuring points are obtained by QR decomposition, and the number of sensor layout is determined by MAC criterion. For the plane tensile membrane structure, three traditional methods are used to determine the optimal position of the sensor: effective independence method, modified effective independence method and column principal component QR decomposition method. Three different fitness functions are constructed based on the root mean square of off diagonal elements of MAC matrix, the elements of Gramian matrix and their organic combination. The particle swarm optimization algorithm is used to realize the optimal sensor placement of plane tensile membrane structure. Finally, the optimal sensor placement results of effective independence method, QR decomposition method and particle swarm optimization algorithm are evaluated and compared. The results show that the particle swarm optimization method can ensure the better linear independence of the mode shape vectors and the better estimation of the modal parameters.