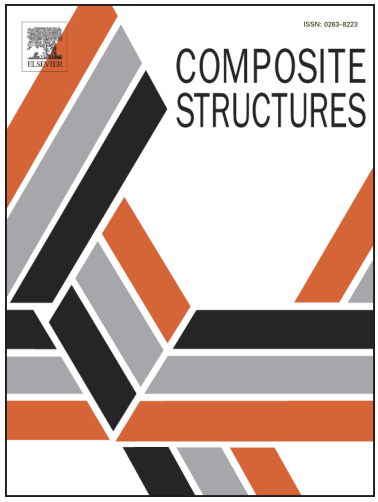

Design and Analysis of Filament-wound Composite Pressure Vessels Based on Non-geodesic Winding

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Abstract: In this paper a novel design approach was proposed for determining the optimal winding parameters of composite pressure vessels based on non-geodesic trajectories. With the aid of the differential theory and winding principles, the non-geodesic trajectories were derived for various tangent points. The obtained non-geodesics for composite pressure vessels were simulated using MATLAB to verify the validity of the trajectory design. The influence of the number of the tangent points and the roving bandwidth on the non-geodesic winding patterns was evaluated. The optimal number of the tangent points and the roving bandwidth were then determined while ensuring fiber stability and full coverage on the mandrel. The finite element model of the pressure vessel was established, taken variable ply thicknesses and angles along the dome meridian into account. In addition, the stress distributions of the aluminum liner and the composite overwrap were obtained and the burst pressure of the pressure vessel was predicted. The specimen of a composite pressure vessel was fabricated using the filament winder and the experimental results were consistent with the theoretically predicted ones. It is concluded that the present method is of great significance for design and manufacture of composite pressure vessels.

Keywords: Composite material; Filament winding; Pressure vessel; Non-geodesic; Winding pattern

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