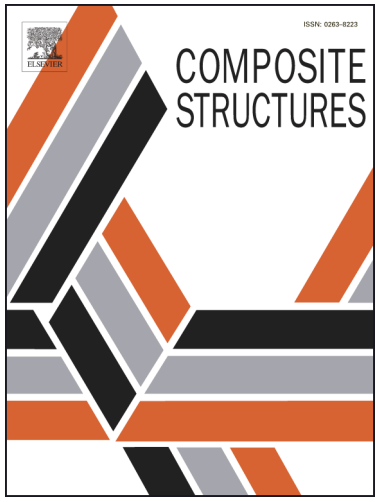

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Structural Strength and Laminate Optimization of Self-Twisting Composite Hydrofoils using a Genetic Algorithm

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Abstract:

This paper presents a novel optimisation scheme using a Genetic Algorithm (GA) to produce a shape-adaptable composite hydrofoil. Importantly the scheme included additional constraints that ensure that the hydrofoils produced were able to be manufactured and have sufficient structural integrity to allow hydrodynamic testing in a cavitation tunnel. Hydrofoils optimised by this scheme were then manufactured using a closed mould resin transfer moulding (RTM) process. Experimental modal analysis (EMA) as well as static cantilever load tests was then performed on the hydrofoils to characterise their mechanical response. The EMA results showed that the hydrofoils could be produced with excellent reproducibility with differences in natural frequencies in the order of 1%. The static cantilever results showed the predicted shape change occurred under load and that the hydrofoils had sufficient strength to permit hydrodynamic testing. The results obtained were also used to validate the finite element analysis (FEA) approached used to predict the hydrofoils structural response.

Key words: Genetic Algorithm (GA), optimisation, Finite Element Analysis (FEA), Resin Transfer Moulding (RTM), Experimental Modal Analysis (EMA)