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C1Po3A-01: Optimization design of the brake impeller for cryogenic hydrogen turbine expanders

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In recent years, with the widespread adoption of hydrogen as a clean energy source, low-temperature hydrogen turbine expanders have played a crucial role in the production of liquid hydrogen. Currently, there is limited focus on the brake side, despite the interdependence and mutual influence between the brake impeller and the turbine impeller. To improve the efficiency and reliability of turbine systems, this paper proposes an optimization design method for brake impellers in hydrogen low-temperature turbine expanders based on artificial neural networks (ANN). The optimization process is divided into four steps: parameterizing the impeller model, building an automated CFD computation platform, generating a sample library, and model parameterization. During the optimization process, the meridional plane and blade shape are optimized sequentially. Comparative analysis of the optimization results shows that the efficiency of the optimized impeller increased by 10.61%, while leakage loss, recirculation loss, and wake mixing were significantly reduced. This method provides an efficient and reliable optimization tool for the design of hydrogen low-temperature turbine systems, with broad engineering application prospects.

Keywords: hydrogen turbine expanders; brake impeller; artificial neural networks; optimization design

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