离心泵叶轮正反问题迭代设计方法 Centrifugal Pump Impeller Design by Using Direct Inverse Problem Iteration

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关键词： 离心泵 叶轮 流场计算 设计

摘 要： 基于流体的连续方程和运动方程，建立了S1流面速度势函数方程和S2流面速度梯度方程，并通过两类相对流面的迭代求解完成了离心泵内部流场的正问题计算。基于正问题计算得到的轴面流场，应用逐点积分法进行叶片绘型，在轴面上加厚叶片，在保角变换平面上修圆叶片头部，实现了离心泵叶轮的反问题设计。利用正问题计算的轴面流场进行反问题设计，将反问题设计得到的叶轮进行正问题计算，正反问题迭代计算直至收敛，得到最终设计的叶轮。该方法反问题设计所需的轴面速度采用叶轮正问题计算的结果，弥补了传统设计方法中轴面速度根据一元假定给出的缺陷，设计得到的叶轮负荷均匀、效率高、抗空化性能好，同时具有设计计算精度高、叶片表面光滑、数据齐全、便于数控机床加工制造等特点。Based on the continuity and motion equations of fluid, the velocity potential functional equation of the S1 stream surface and the velocity gradient equation of the S2 stream surface were established. The flow field of the direct problem was solved by calculating the two families of stream surfaces. Based on the flow field of the direct problem, the inverse problem of centrifugal pump in drawing blade shape by point-by-point integration, thickening blade and smoothing leading edge of the blade by conformal mapping was accomplished. By using the flow field of the direct problem calculated by the impeller of the inverse problem to design the impeller, and using the impeller of the inverse problem designed by the flow field of the direct problem to calculate the flow, the final impeller was designed when the direct and inverse problems was converged. This method which applies the meridional velocity of direct problem result to inverse problem, can make up the deficiency of traditional design method by using one-dimensional flow assumption. The final impeller can distribute load equally with the characters of high efficiency and excellent cavitation performance. This method can increase the efficiency of design work and the accuracy of calculating results. The data of the blade’ s surface is complete which is convenient for blade manufacturing by numerical control machine.