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Shape Optimization of A Turbine-99 Draft Tube Using Design-by-Morphing SAHUCK OH, CHUNG-HSIANG JIANG, PHILIP MARCUS, University of California, Berkeley, DAVID GUTZWILLER, ALAIN DEMEULENAERE, NUMECA USA, Inc., CHIYU JIANG, University of California, Berkeley — We have found the optimal shape of a turbine-99 draft tube that maximizes its pressure recovery factor using a new design method called design-by- morphing. In design-by- morphing, new draft tubes are created by morphing multiple baseline draft tubes with different weights. The surfaces of baseline draft tubes are approximated by a summation of spectral coefficients multiplied by spectral basis functions. Then, a morphed draft tube is produced by computing a new set of spectral coefficients which are a weighted average of the spectral coefficients of the baseline draft tubes. The optimal draft tube is obtained by finding the weights such that the mean pressure recovery factor is maximized. After optimization is carried out using design-by- morphing, the high static pressure region is significantly reduced, and the flow is smoother and more uniform than it was in any of the baseline turbine-99 draft tubes. The optimal draft tube shows a 10.9% improvement over the turbine-99 draft tube. We have applied this method to trains and to aircrafts, and have reduced the drag and the drag-to-lift ratio by 13.2% and 23.1%, respectively. We believe that this optimization method is applicable to many engineering applications in which the performance of an object depends on its shape.

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