Flow Analysis of a Wave-Energy Air Turbine with the SUPG/PSPG Stabilization and Discontinuity-Capturing Directional Dissipation

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ABSTRACT

We present a flow analysis of a wave-energy air turbine, commonly known as Wells turbine. The focus here is on the computational method used in the analysis, based on the Streamline-Upwind/Petrov-Galerkin (SUPG) [1] and Pressure-Stabilizing/Petrov-Galerkin (PSPG) [2] stabilizations and the Discontinuity-Capturing Directional Dissipation (DCDD) [3, 4]. The SUPG/PSPG stabilization is used rather widely and successfully. The DCDD, first introduced to complement the SUPG/PSPG method in computations of incompressible flows in the presence of sharp solution gradients, was also shown to perform well in standard turbulent-flow test computations when compared to the Smagorinsky Large Eddy Simulation (LES) model. The results obtained [5] in our computational analysis of the Wells turbine here compare favorably to the available experimental data, and this demonstrates that the DCDD method performs well also in turbomachinery flows.

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