On the extraction of pressure fields from PIV velocity measurements in turbines ARTURO VILLEGAS, FANCISCO J. DIEZ, None — In this study, the pressure field for a water turbine is derived from particle image velocimetry (PIV) measurements. Measurements are performed in a recirculating water channel facility. The PIV measurements include calculating the tangential and axial forces applied to the turbine by solving the integral momentum equation around the airfoil. The results are compared with the forces obtained from the Blade Element Momentum theory (BEMT). Forces are calculated by using three different methods. In the first method, the pressure fields are obtained from PIV velocity fields by solving the Poisson equation. The boundary conditions are obtained from the Navier-Stokes momentum equations. In the second method, the pressure at the boundaries is determined by spatial integration of the pressure gradients along the boundaries. In the third method, applicable only to incompressible, inviscid, irrotational, and steady flow, the pressure is calculated using the Bernoulli equation. This approximated pressure is known to be accurate far from the airfoil and outside of the wake for steady flows. Additionally, the pressure is used to solve for the force from the integral momentum equation on the blade. From the three methods proposed to solve for pressure and forces from PIV measurements, the first one, which is solved by using the Poisson equation, provides the best match to the BEM theory calculations.

Arturo Villegas
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