PIV-based estimation of unsteady loads on a flat plate at high angle of attack using momentum equation approaches AMANDINE GUISSART, University of Liege, LUIS BERNAL, University of Michigan, GREGORIOS DIMITRIADIS, VINCENT TERRAPON, University of Liege — The direct measurement of loads with force balance can become challenging when the forces are small or when the body is moving. An alternative is the use of Particle Image Velocimetry (PIV) velocity fields to indirectly obtain the aerodynamic coefficients. This can be done by the use of control volume approaches which lead to the integration of velocities, and other fields deriving from them, on a contour surrounding the studied body and its supporting surface. This work exposes and discusses results obtained with two different methods: the direct use of the integral formulation of the Navier-Stokes equations and the so-called Noca's method. The latter is a reformulation of the integral Navier-Stokes equations in order to get rid of the pressure. Results obtained using the two methods are compared and the influence of different parameters is discussed. The methods are applied to PIV data obtained from water channel testing for the flow around a 16:1 plate. Two cases are considered: a static plate at high angle of attack and a large amplitude imposed pitching motion. Two-dimensional PIV velocity fields are used to compute the aerodynamic forces. Direct measurements of dynamic loads are also carried out in order to assess the quality of the indirectly calculated coefficients.

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