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Thermographic Analysis of Mechanical Disturbances Effects on Laminar Separation Bubble

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Abstract

The Laminar Bubble is a local boundary layer separation phenomenon that may occur on aerodynamic bodies operating at low Reynolds numbers. The effect of acoustic disturbances on the laminar bubble behaviour was illustrated in a previous work (Qirt 2006); in this paper are presented the results obtained by means of a M.E.M.S placed inside the tested airfoil. The experimental analyses are carried out in the wind tunnel of the "Università Politecnica delle Marche" - Department of Energetic. The IR visualizations are obtained by means of the "heated thin foil technique". The temperature distribution is post-processed by using a Matlab code that allows to obtain the local Stanton number distribution over the airfoil surface. This analysis is performed by varying the airfoil angle of attack and the operating Reynolds number. The results show a laminar bubble reduction by using the M.E.M.S. disturbance effect; the reduction is related to the disturbances frequency and to the bubble position on the airfoil surface. The adverse pressure gradient, related to the airfoil angle of attack, and the local Reynolds number (based on the thickness displacement) are the main parameters that influence the wave disturbance development inside the boundary layer. For the tested angles of attack and Reynolds number the bubble presence is not avoided but there is a marked longitudinal extension reduction: this is clearly observed in the thermographic results.

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