TURBINE BASE PRESSURE ACTIVE CONTROL THROUGH TRAILING EDGE BLOWING

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In transonic and supersonic turbomachinery, shock waves appear at the trailing edge, generating substantial losses due to the interaction with the boundary layer. To control the resulting fish tail shock waves, pulsating coolant blowing through the trailing edge of the airfoils was experimentally and numerically studied for the first time. A linear cascade representative of modern turbine bladings was specifically designed and constructed. The test matrix comprised four Mach numbers, from subsonic to supersonic regimes (0.8, 0.95, 1.1 and 1.2) together with two engine representative Reynolds numbers (4 and 6 x 10^6) at various blowing rates. The blade loading and the downstream pressure distributions allowed understanding the effects on each leg of the shock structure. Minimum shock intensities were achieved using pulsating cooling. A substantial increase in base pressure was observed for low coolant blowing rate. Pulsating cooling provided higher base pressure than continuous coolant ejection. Analysis of the high frequency Schlieren pictures revealed the modulation of the shock waves with the coolant pulsation. The Strouhal number of the vortex shedding was analyzed for all of the conditions. Heat transfer measurements were performed to quantify the consequences of different coolant blowing schemes. Shock angle variation and intensity reduction has been quantified at different cooling rates. Shock induced boundary layer transition has been identified with both continuous and pulsating coolant ejection. The most significant improvements were attained by the pulsating cooling.

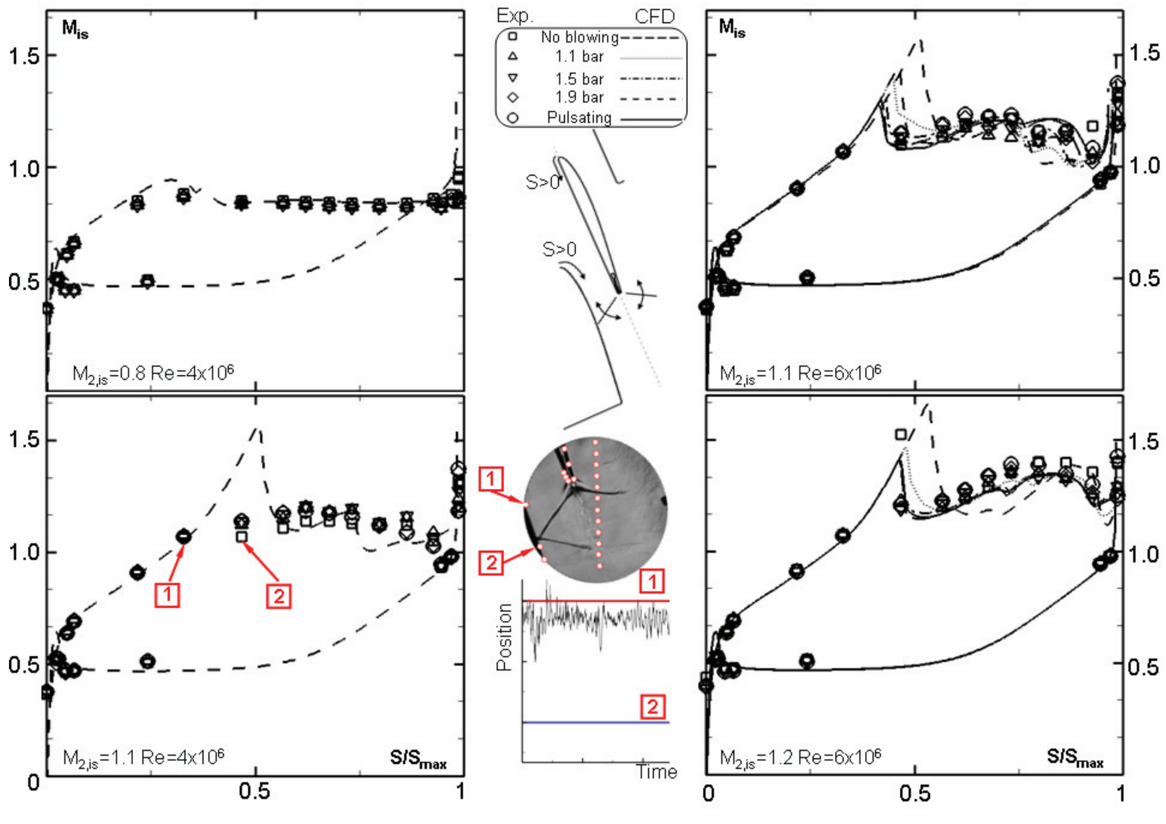

Figure 1 : The variation of velocity distribution of upper channel for various test conditions