

INFLUENCE OF THE SYNTHETIC JET ON THE FLOW AROUND THE HUMP

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Abstract: *The work deals with measurement of characteristics of the synthetic jet generator. Synthetic jet mean velocity in dependence of the parameters of actuating signal (type of signal, frequency, electrical current value) and the velocity profile in the wake behind the hump with controlled boundary layer was studied. A hot wire anemometry method (HWA) measurement technique was used. Profiles of the mean velocity and turbulence intensity behind hump was evaluated. Variants with and without the synthetic jet were measured and compared.*

Keywords: *Boundary layer, flow control, HWA, synthetic jet, wake.*

1. Introduction

For the purpose of investigation of the flow with controlled boundary layer behind the aerodynamic obstacle in the laboratories of the Department of Fluid Mechanics and Thermodynamics 12112, was rebuilt sucked open wind tunnel with a closed test section, including measuring equipment. Synthetic jet was chosen as method of active boundary layer control.

2. Model with synthetic jet generators

The block of nine synthetic jet generators is installed inside the model. The outcome of generators is connected smoothly to the top surface of the model, see Fig. 1.

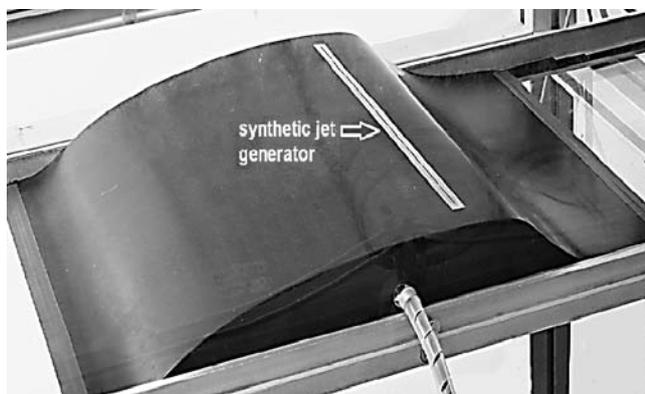


Fig. 1 Model in the measuring space

3. Synthetic jet generator calibration

The calibration of the synthetic jet generator is to determine dependence of the intensity/velocity u_0 of the synthetic jet on exciting frequency, type of signal and input electrical current value. Time average value of the velocity of the synthetic jet is defined:

$$u_0 = \frac{2}{T} \cdot \int_0^{\frac{T}{2}} u_0(t) \cdot dt \quad (1)$$

where $u_0(t)$ is the instantaneous generated velocity and T is positive period of the signal.

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In Fig. 2, the mean velocity u_0 dependence on frequency of sine type excitation signal is visible. Value of input current of the excitation signal was constant in this case. Measuring system with hot wire probe (HWA) was used. Maximum mean velocity u_0 of generated synthetic jet was about 11,5 [m/s]. Maximum intensity of the synthetic jet for excitation frequency of 370 [Hz] was found.

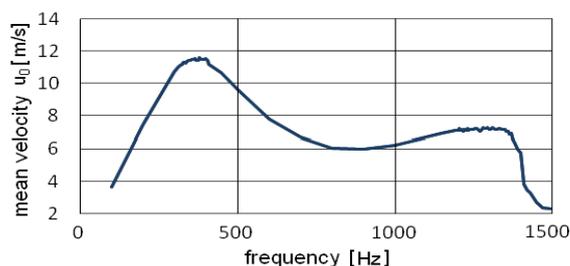


Fig. 2 Frequency characteristic

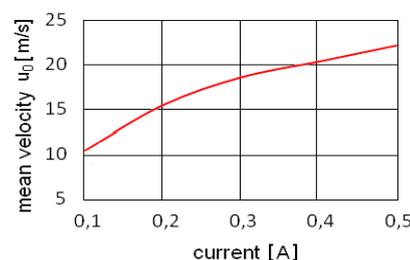


Fig. 3 Current characteristic

The dependence of mean velocity of the synthetic jet on input current value with sine type excitation signal for resonant frequency is shown in Fig. 3. This characteristics is useful to define the input current value which corresponds to the required velocity u_0 of the synthetic jet.

4. Wind tunnel measurement

The excitation signal for measurement was sine type modulated by rectangular signal. The sine type signal – carrying was created on resonant frequency of the actuator – 370 [Hz].

Evaluated was the mean velocity value, and turbulence intensity. An example for wind tunnel drive 1740 rpm - see Fig. 4. Measurements were made with and without the synthetic jet. Both cases was compared.

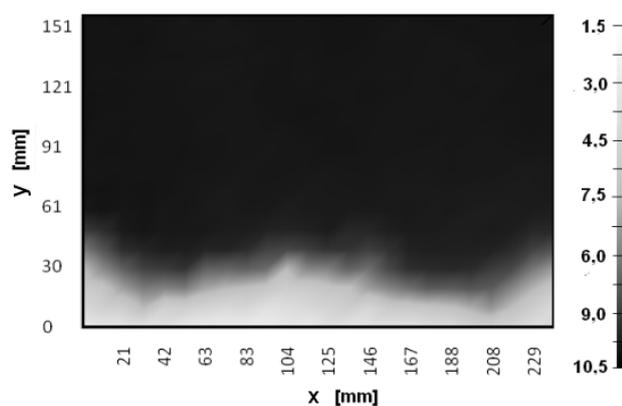


Fig. 4 Mean velocity, sinus signal 370 [Hz], modulation 60 [Hz], synthetic jet velocity 11,5 [m/s]

5. Conclusions

It was found, that the synthetic jet have positive influence on the flow. Dominant vortex structures can be observed probably in the wake behind the model. The mean velocity in non-influenced part of cross-section increased from 9,8 [m/s] to 10,1 [m/s]. The wake magnitude was reduced. The maximum of turbulence intensity in the wake was decreased from 60% to 50%.

Acknowledgment

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