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ON INSTABILITY WAVE CONTROL IN TURBULENT JETS

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Abstract. The presentation is based on two main results obtained in the framework of international projects OPENAIR and ORINOCO. Two considered effects are determined by control of large scale structures in the initial part of shear layer. In the first part we have studied experimentally how plasma actuators operating on the basis of surface barrier high frequency discharge affect jet noise characteristics [1]. An actuator's effect on the jet in the applied configuration is related to acoustic discharge excitation and to a large extent is similar to the well-known Vlasov–Ginevsky effect. Thus, the results of investigations of air jets (100–200 m/s) have demonstrated that jet excitation in the case of St ~ 0.5 using the barrier discharge plasma actuator leads to broadband amplification of jet sound radiation. The jet excitation in the case of St > 2 leads to broadband noise reduction if the action is sufficiently intensive (Fig. 1).

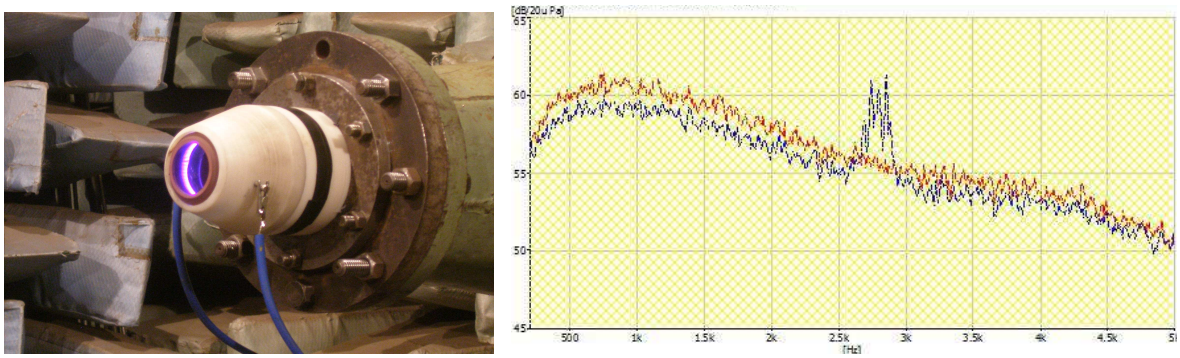

Fig. 1. Noise control by high frequency plasma actuator excitation

In the second part we considered experimental investigations of possibility of instability waves control in jet shear layer of turbulent jet [2]. Basic possibility of artificial hydrodynamic instability wave suppression in turbulent jet by external action (acoustic or plasma actuator), which was predicted theoretically, is demonstrated in experiment. Different jet velocities (up to 280 m/s) are considered for control demonstration. This result may be used for development of jet noise active control system since the instability waves can be dominant sound source in high-speed jets. A closed-loop feedback system has been developed for active control of artificially excited instability waves (Fig. 2). Direct suppression of the instability wave generated inside the jet by an plasma actuators positioned outside and inside the nozzle is demonstrated.

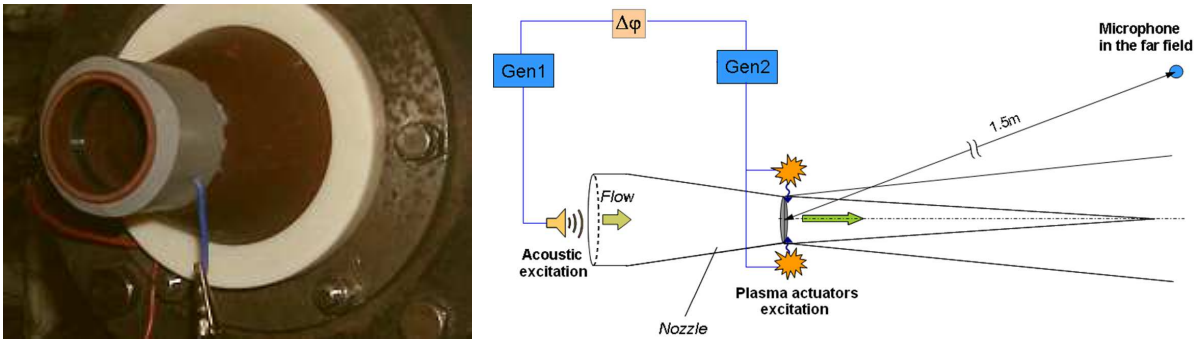

Fig. 2. Instability wave control in turbulent jet

Keywords: turbulent jet, plasma actuators, jet excitation, noise reduction, instability waves control, active noise control system.

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