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Evaluation of Jet Sheet Strength against Vortex Pair Collisions

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Extended Abstract

Jet flows have long been used in various fields, and advanced jet flow technology is required for personal air conditioning and ductless exhaust ventilation. Numerous studies have been conducted on the basic flow characteristics of jets from various viewpoints [1]. For two-dimensional jets, not only have there been reports on jet structures such as jet center velocity decay [2], [3], jet width expansion [4], [5], and jet entrainment [6], but also detailed discussions on the coanda effect [7] and turbulent characteristics [8]. However, discussions on jet strength have been far from sufficient; in particular, the relationship between the flow characteristics of jets and disturbances caused by human movement, the opening and closing of windows, and other factors remains unclear. Recently, there has been interest in a virtual partitioning method the uses jets without objects to control droplet infection in relation to pandemic control. In this context, it is necessary to investigate flow characteristics, such as the jet intensity and post-disturbance repair process, by using human coughing as the disturbance.

In this study, a speaker-generated vortex pair (synthetic jet of finite duration) was created to collide with a continuous steady jet in the vertical direction. Experimental and numerical simulations were performed to evaluate the jet strength by focusing on the velocity fluctuation of a continuous jet and the time required for the jet to recover its original state. The main parameters were the location of the disturbance (vortex pair) generation (x-distance from the origin) and momentum ratio (momentum ratio of the disturbance to the main jet).

The main result was that the influence of the vortex pair (disturbance) on the behavior of the continuous steady jet increased as the momentum ratio increased. The results also revealed that vortex pairs penetrated the jet when a certain momentum ratio was reached and that the behavior of the main jet was strongly dependent on the location of disturbance generation under equal momentum ratio conditions.

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