

Preface

Stability of jets and combustion of jet fuels are the focus of long-term studies due to both fundamental and engineering aspects of these phenomena. A wealth of research data on this topic is available today and reported in original journal papers, reviewing articles, and monographs. In the present e-book, we consider, most of all, the influence of initial conditions at a nozzle exit and acoustic effects on round and plane, macro- and microjets at low subsonic velocities, according to our experience in experimental work on this subject. We expect that the material presented here will be of interest to high school teachers, university students, and researchers engaged in jets-related problems.

Organization of the Book

In Chap. 1, we present a review of the main works devoted to the studies of conventional and combusting subsonic jet instabilities.

In Chap. 2, we begin with the dynamics of a round jet emphasizing the contribution of longitudinal disturbances to the perturbed flow pattern. Important issues are generation, spatial development, and interaction of three-dimensional streaky structures with ring vortices.

In Chap. 3, we proceed with plane jets, focusing again on the formation and development of longitudinal structures of laminar flow disturbances and their interaction with the Kelvin–Helmholtz vortices. We then present some visualization results on a free jet, followed by a detailed consideration of a perturbed wall jet.

Obviously, evolution of the jet depends on the initial conditions at the nozzle exit. In particular, varying nozzle geometry and, hence, the velocity distribution

near its exit, it is possible to modify instability of a jet and its dynamics. Such an approach to control of round jets is the main subject of Chap. 4.

In Chap. 5, laminar and turbulent round jets are under further consideration. Experimental data testify to the similarities of the generation and development of coherent structures in both cases. Also, almost one and the same response of jets to external acoustic oscillations is demonstrated.

The influence of initial conditions at a nozzle exit and acoustic perturbations on a plane jet structure, its evolution and stability, is considered in Chap. 6. We demonstrate basic features of laminar and turbulent plane jets at one and the same Reynolds number. It is found that jets are subjected to sinusoidal oscillations suppressing the varicose mode of instability. The focus here is the interaction of the longitudinal structures of flow perturbations generated at one side of the nozzle, with the large-scale two-dimensional vortices of the laminar plane jet resulting in origination of Λ - or Ω -shaped vortex structures.

In Chap. 7, we present experimental and numerical data, compiled by studying characteristics of round jets with a top hat and a parabolic mean velocity, which exhibit profiles at the nozzle exit in a cross-flow. In the case of parabolic velocity distribution, flow instability results in the jet deformation appearing as tangential bursts of fluid so that a pair of counter rotating stationary vortices is generated and the jet core is diminished. As is found, the jet/cross-flow interfaces might have undergone a “stretching and thinning” process caused by the cross-flow.

In Chap. 8, we consider the effect of a transverse acoustic field on round and plane, macro- and microjets at small Reynolds numbers.

Finally, Chap. 9 focuses on the jet flames at low Reynolds numbers. When forcing propane jets by transverse acoustic oscillations, new features of combustion were observed and explained.

Supplementary Material

Most of the above listed chapters are supplemented by multimedia files providing visual illustrations of the phenomena discussed in the body of the present book.

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