DISCRETE FREQUENCY SOUND GENERATION BY FLUID FLOWS

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Generation of discrete frequency tones by fluid flow processes is not only of fundamental interest, but also is of considerable importance in many practical applications. This paper will describe and discuss, through selected examples, the nature of such tones and the physical features underlying their generation. The main concern will be with sound generation by free shear layers (such as free jets, separated boundary layers, and wakes), vortex wakes, wall-bounded jets, and with sound generated by the interaction of such flows with rigid surfaces. The general characteristics of the sound fields will be described, and the physical mechanism of their generation will be discussed. The features common to the different problems will be brought out. Discrete tone generation rests on features such as the stability of the flows involved, organized structures, if any, and on their interactions with surfaces present. The role and relative importance of these various features will be discussed in light of relevant experimental results. Relevant theoretical concepts will be discussed. The paper will attempt to bring out clearly our present understanding of the problems and the still open physical questions.

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The following specific flow problems will be treated: a free jet; a jet interacting with a rigid surface; a free-mixing layer; such a layer interacting with a surface; flow past a cavity in a surface; a vortex wake behind a bluff body; such a wake interacting with a surface; a wake from a streamlined body such as an airfoil, and its interaction with a surface; a wall jet, and such a jet interacting with a surface. The various geometric and dynamic parameters governing the flow and sound fields will be detailed, and discussion will be presented in terms of them. The flow and sound fields involved will be described by means of visualization studies and quantitative measurements.

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FLUID DYNAMICS OF THE MONSOONS

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In its simplest form, the atmospheric circulation in the tropics can be thought of as axi-symmetric convection of a rotating fluid forced by a spatially varying heat flux applied at its lower boundary, since most of the incident solar radiation is absorbed at the surface of the earth. This convective cell is characterized by a narrow zone of ascending fluid located over the region of maximum heating and a broad zone of descending fluid elsewhere. There is flow towards the rising limb i.e. convergence at the lower levels and divergence aloft. Due to the rotation, however, the predominant horizontal component of the wind is parallel (rather than normal) to the zone of ascent and blows in opposite directions on either side of it. This zone of ascent, associated with high cyclonic (i.e. same sign as the rotation) vorticity and convergence at the lower levels is delineated in our moist atmosphere as a narrow band of convective clouds stretching almost continuously around the globe at low latitudes and is called the intertropical convergence zone (ITCZ).

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The location of the ITCZ changes in response to the seasonal variation in the latitude of incidence of maximum solar radiation. This implies a seasonal reversal of the winds in the region over which the ITCZ sweeps in its seasonal migration.