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Detonation Waves in Gas Daynamics

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The laws of conservation of mass, momentum, and energy that form the basis for the equations of inviscid flow of a nonconducting gas do not necessarily assume continuity of the flow variables. These laws were originally formulated in the form of differential equations simply because it was assumed that the flow is continuous. These laws, however, can also be applied to the flow regions where the variables undergo a discontinuous change. From a mathematical point of view, a discontinuity can be regarded as the limiting case of very large but finite gradients in the flow variable across a layer whose thickness tends to zero. Since in the dynamics of an inviscid and nonconducting gas (with molecular structure disregarded) there are no characteristic lengths, the possibility of the existence of arbitrarily thin transition layers is not excluded. In the limit of vanishing thickness when the gradient is very large, the flow variables exhibit discontinuities which correspond to shock waves. Detonation waves are physicochemical propagating structures that are composed of a lead shock wave which initiates chemical reaction in the reactive material. In other words, detonation waves are compressive, exothermically reacting shock waves. This lecture is a survey of recent advances and problems about detonation and shock waves in gas dynamic.

Key words: conservation law, detonation wave, shock wave.