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TIME-RESOLVED VISUALIZATION OF TRANSIENT COMPRESSIBLE FLOWS

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In the last few years, new developments in high-speed camera technology have considerably widened the scope of the investigation of highly transient compressible flow processes. These camera developments have removed some of the limitations inherent to the traditional method of reconstructing a transient process from a series of single images, each taken in a different experiment at a different instant. Most of the techniques developed for the visualization of compressible flows can be used in time-resolved mode, which allows one to show, from the records of a single experiment, how certain flow features develop. With such records it is possible to clearly distinguish between cause and consequence in a complex process. In this way, time-resolved visualization contributes much to the qualitative explanation of flow processes. In addition, it provides quantitative information about a flow, as one can track the location and/or shape of flow features in space and time. Such data would only be available from single-image visualizations, if the process in question were extremely reproducible.
This paper will outline some of the recent developments in this field, and it will discuss the potential and the limitations one encounters when using various density-sensitive visualization techniques in time-resolved mode. Several examples with the application of various visualization techniques illustrate how this approach can reveal and explain a number of previously undetected phenomena in a variety of highly transient compressible flows. It is demonstrated that time-resolved visualization offers numerous advantages which often outweigh its shortcomings, which in most cases are related to a so far inevitable loss in spatial resolution.