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High strain rate characterization of soft materials: past, present and possible futures

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The high strain rate properties of low impedance materials have long been of interest to the community: the very first paper by Kolsky on his eponymous bars included data from man-made polymers and natural rubber. However, it has also long been recognized that characterizing soft or low impedance specimens under dynamic loading presents a number of challenges, mainly owing to the low sound speed in, and low stresses supported by, these materials. Over the past 20 years, significant progress has been made in high rate testing techniques, including better experimental design, more sensitive data acquisition and better understanding of specimen behavior. Further, a new generation of techniques, in which materials are characterized using travelling waves, rather than in a state of static equilibrium, promise to turn those properties that were previously a drawback into an advantage. This paper will give an overview of the history of high rate characterization, the current state of the art after an exciting couple of decades and some of the techniques currently being developed that have the potential to offer increased quality data in the future.