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An Electromagnetic Gauge Technique for Measuring Shocked Particle Velocity in Electrically Conductive Samples DAVID CHENG, AKIO YOSHINAKA, Defence Research and Development Canada - Suffield — Electromagnetic velocity (EMV) gauges are a class of film gauges which permit the direct in-situ measurement of shocked material flow velocity. The active sensing element, typically a metallic foil, requires exposure to a known external magnetic field in order to produce motional electromotive force (emf). Due to signal distortion caused by mutual inductance between sample and EMV gauge, this technique is typically limited to shock waves in non-conductive materials. In conductive samples, motional emf generated in the EMV gauge has to be extracted from the measured signal which results from the combined effects of both motional emf and voltage changes from induced currents. An electromagnetic technique is presented which analytically models the dynamics of induced current between a copper disk moving as a rigid body with constant 1D translational velocity toward an EMV gauge, where both disk and gauge are exposed to a uniform external static magnetic field. The disk is modelled as a magnetic dipole loop where its Foucault current is evaluated from the characteristics of the fields, whereas the EMV gauge is modelled as a circuit loop immersed in the field of the magnetic dipole loop, the intensity of which is calculated as a function of space and, implicitly, time. Equations of mutual induction are derived and the current induced in the EMV gauge loop is solved, allowing discrimination of the motional emf. Numerical analysis is provided for the step response of the induced EMV gauge current with respect to the Foucault current in the moving copper sample.

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