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ABSTRACT

Nondestructive evaluation is used widely in many engineering and industrial areas to detect defects or flaws such as cracks inside parts or structures during manufacturing or for products that need to be inspected while in service. The commonly-used standard statistical model for such data is a simple empirical linear regression between the (possibly transformed) signal response variables and the (possibly transformed) explanatory variable(s). For some applications, such a simple empirical approach is inadequate. An important alternative approach is to use knowledge of the physics of the inspection process to provide information about the underlying relationship between the response and the explanatory variable or variables. Use of such knowledge can greatly increase the power and accuracy of the statistical analysis and enable, when needed, proper extrapolation outside the range of the observed explanatory variables. This paper describes a set of physical model-assisted analyses to study the capability of two different ultrasonic testing inspection methods to detect synthetic hard alpha inclusion defects in titanium forging disks.