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Identifying and Correcting Biases in Digital Image Correlation at Multiple Length Scales

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ABSTRACT

Accurate strain measurement at grain and sub-grain levels is important to predict and understand crack initiation during fatigue of materials. During cyclic loading, low magnitude strain is accumulated in the material and any distortion in the images can lead to inaccurate strain measurements and false prediction of the material's behavior. Digital Image Correlation (DIC) is a reliable tool used to measure strain localization by correlating images before, during, and after cyclic loading. DIC tracks the deformation of nano/micro-scale patterns placed on the surface of the specimens to determine strain fields. However, DIC software does not account for biases due to specimen misalignment, stress relaxation, light and contrast divergences, or image distortions when using Scanning Electron Microscopy (SEM). The work presented here establishes a protocol to collect and correct images that accounts for the biases induced during SEM capture. This protocol describes a procedure for image capture and a specific post-processing computational technique for distortion correction on SEM images. The combination of both methodologies allows for unbiased strain measurement and localization when using DIC software at different length scales.

KEYWORDS

Digital Image Correlation, Scanning Electron Microscopy image distortions, Strain biases.