Microstructure characterization of high explosives by wavelet transform

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Abstract

The key macro properties of high explosives including sensitivity to shock, the possibility of initiation, and the subsequent chemical reaction are known to be controlled by processes occurring at their microstructure level. However, there is the lack of an easy, effective and accurate method to quantify the microstructure, termed as fabric, of high explosives despite an abundance of evidence regarding its importance. This study proposes a rotational Haar wavelet transform (RHWT) method to characterize the fabric of high explosives from two-dimensional images, yielding key fabric parameters including rose diagram, fabric direction, degree of fabric anisotropy. The fabric tensor commonly used in numerical simulations and constitutive models can also be determined by RHWT. The RHWT was implemented on microscopic images of six high explosives captured by various imaging techniques including by scanning electrical microscopy, polarized light microscopy, and micro X-ray computed tomography. Despite of these variables, the proposed RHWT successfully identifies fabric in these images, demonstrating robustness and validity of RHWT.

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