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Development of a radial basis function neural network for the recognition of common phases present in carbon steel metallographs

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Abstract

While research has been done in applying digital image processing and neural networks to the recognition of phases and inclusions in materials such as cement and iron, little to no research has focused on recognition of steel phases. This research focuses on the automated recognition of ferrite, pearlite, cementite, and martensite from digital images of carbon steel metallurgical specimens. Digital metallographs were converted to grayscale images and then keypoints from these images were located. An area around each keypoint was extracted as a separate sub-image then reduced to four levels of gray. Using *Mathematica*, features such as statistical measures of texture (image histograms, entropy, energy, contrast, and homogeneity) and the basic pixel counts from a binarized version of the sub-image were calculated. These features were used as input to a radial basis function neural network. Training and validation data for these features were generated from the sub-images. Using a radial basis neural network (available as a *Mathematica* add-in) with one output for each phase, it was demonstrated that these features were sufficient to differentiate between all four phases, with a root mean square error of 22.4%. By eliminating cementite from consideration, a root mean square error of 16.2% was achieved.

Biography

Sara McCaslin completed her PhD in mechanical engineering at The University of Texas at Arlington, and a MS in computer science at The University of Texas at Tyler. She is currently an assistant professor of mechanical engineering of UT Tyler, where she pursues research in image processing, finite element analysis, and online education.