Extracting Microstructure from Imager

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Materials Science is somewhat unique in that microscopic observations are used to infer an “idealized structure” of a material that is then used in subsequent quantitative modeling of material behavior. That is, the “real” representation of a structure is a cognitive perception within the researcher’s mind, as opposed to one directly related to phenomenology. Complicating matters, when we speak of “microstructure,” we often mean some sort of nebulously defined statistical description of the structure, whose characteristics we intuitively recognize as part of our perception, but that require some thought when automating by computers. In this work, we model microstructure of a continuous fiber composite as a continuous “field variable” that describes the local shearing, rotation, dilation, and contraction of the fibers embedded in the matrix. Since the model is local, we are able to capture the statistical behavior of the structure by variations in the field from point to point. But, a fair amount of processing is necessary to convert image data to a field variable: extraction of fiber center positions, association of fibers through multiple images to assemble into 3-D objects, from which control points for fitting a field model may be employed. Subsequent analysis allows for identification of the various features of the fields. Since the model is local, it is also possible to use anomaly testing to separate anomalous from typical features. This presentation will give the current state of our efforts with continuous fiber SiC/SiC composites.