COMPLEX FIBER ARCHITECTURE MORPHOLOGY: 3D MICROSTRUCTURAL CHARACTERIZATION AND RECONSTRUCTION FOR NUMERICAL ANALYSIS

David Mollenhauer[^] and Eric Zhou[&]

[^] Air Force Research Laboratory (AFRL),
Wright-Patterson AFB, OH 45433-7750
David.Mollenhauer@wpafb.af.mil

[&]University of Dayton Research Institute (UDRI)
300 College Park Ave.,
Dayton, OH 45469-0168

Highly accurate yarn geometry information is critical for prediction of local stress variations and damage evolution in complex fiber architecture composites. For this reason, it is necessary to obtain morphological information directly experiment. The internal yarn geometry can be experimentally described using a variety of imaging techniques such as optical microscopy, laser ranging, ultrasonic imaging, and computed tomography (CT). Since the resin is everywhere inside of the textile reinforced composite, it distorts the image and introduces a big challenge for image based modeling of 3D textile composites. In this paper we present a new approach to generate the 3D textile composite geometric model based on image processing technique. The idea of this approach is to use image algorithms such as, Guassian, Sober, and Histogram to improve the image quality, detect the yarn edge, remove noise in the image. After obtaining the yarn edge definitions on a given micrographic slice, the data from many slices is combined using Stoke's Theorem to reconstruct the yarn surface. This is then processed with the AFRL-UDRI code Morpho-Modifier to generate a 3D mesh ready model for the traditional finite element analysis (FEA) and a novel B-spline analysis method (BSAM).

Key words: composites, microstructure, textiles