**Title:** *Development of a statistical mechanics-based approach to model the compression flow of long-fiber composite materials*

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**Keywords:** *Long-fiber composites, statistical mechanics, fiber mesostructure, SMC, compression flow modeling, rheological characterization*

**Abstract (without references):**

*Discontinuous fiber composite materials are widely used in industrial applications due to their material properties and good processability. Typically, chopped fibers or fiber bundles are randomly distributed to make pre-impregnated mat structures, which are easy to shape into complex parts. The deformation behavior of these composites is significantly dependent on the characteristics of the fibrous reinforcement, which influence the processing method. Different mechanisms are known to appear during the transformation of discontinuous fiber composites and affect both rheological and mechanical properties of these materials. The fibers are transported in the matrix flow and rotate, spread or deform. This can lead to anisotropic, heterogenous and non-local behaviors, resulting in processing problems and a lack of mechanical performance.*

*In recent years, discontinuous composite materials have been developed for various applications, such as recycled composites or bio-sourced composites, especially for structural applications. Engineering performances require reinforcements with longer fibers, that increase processing issues and heterogeneities for these materials. Current phenomenological models describing the transformation of short-fiber suspensions have difficulty in capturing the complex interactions between the long fibers, and it remains a challenge to predict the mesostructures and properties of the resulting composites.*

*This presentation gives an overview of the development of a new approach to describe discontinuous long-fiber composites and its use to characterize and simulate the compression molding process. A mechanical based framework has been formulated to model the statistical contact forces between long fiber for various concentrations and organizations. The model has been validated by a numerical simulation tool that generates large, complex fiber mesostructures using a mechanical packing approach. The conclusions drawn from this approach were compared with direct observations of fibrous mesostructures and enabled the inclusion of frictional interactions between fibers in rheological and fiber orientation models, thus significantly improving the accuracy of processing simulations.*