DEVELOPING 3D FULLY PARAMETRIC MULTI-SCALE COMPUTATIONAL MODEL FOR NONWOVEN SIMULATIONS

Emrah Demirci[1]

[1]Wolfson School of Mechanical, Electrical and Manufacturing Engineering, Loughborough University

Nonwovens are popular materials and their applications range from hygiene and health care to civil engineering. Understanding and characterisation of their deformation mechanisms are important in the design of new nonwoven products or the improvement of existing ones. However, this is a quite challenging process because of their complex microstructures, particularly their non-uniform fibre orientation distribution, fibre curvature, nonlinear deformation behaviour of constituent fibres. This research focusses on a method to develop a 3D multi-scale, fully parametric computational model. This parametric model can be used for simulating deformation behaviour of nonwovens under tensile and compressive loads as well as their flow behaviour under various operating conditions. The developed model accounts for 3D fibres with various cross-sections and fibre-to-fibre contacts, transmitting the force from one fibre to another. The model allows to perform parametric investigations on fibrous networks. Depending on computational power, wide scales of models from few mm2 to gigantic 3D parametric models for macro-scale analysis can be generated. Furthermore, the morphological characteristics of the nonwoven microstructure can be monitored through this computational model.