Computer Simulation of the Large Deformation of Fabric Structures

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A computer simulation tool has been developed to model various fabric manipulation processes during manufacturing. Nonlinear material response is included in the physical model of the fabric. Simulation results are compared with experimental data to verify the accuracy of the simulation. The simulations are able to account for effects such as: contact, frictional contact, and manipulator path optimization for minimizing reaction or displacement. A finite element approach is taken to discretize the fabric parts. A large deformation beam model is adopted where an equilibrium approach is taken to derive the differential equations of equilibrium. Using the measured moment curvature response for real fabrics, nonlinear material responses of the fabrics are obtained and used in the simulation. The simulation results using linear and nonlinear material responses are compared with experimental data. For each numerical examples, fabric large deformation configurations are obtained with/without fabric manipulator paths minimizing reaction force or displacement. The simulation using nonlinear material response shows superior result to that using linear material response.