

KTex Family for Manufacturing

Predicting the Impact of the Manufacturing Process on Composite Materials

Challenge

Simulate the lay-up manufacturing process of a complex composite part in order to predict the orientation of its fibers and its fiber volume fraction. This study will rely on the meshing power of HyperMesh and the calculation capabilities of RADIOSS. KTex Family tools will be used to build a mesoscopic FE model of several fabrics and to set up a simulation of the manufacturing process.

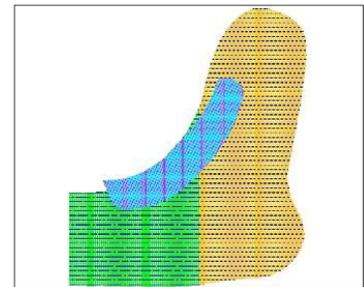
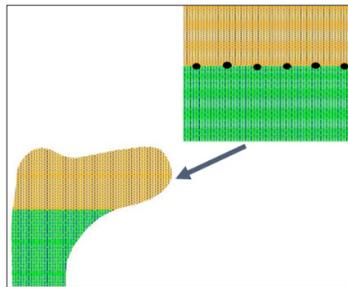
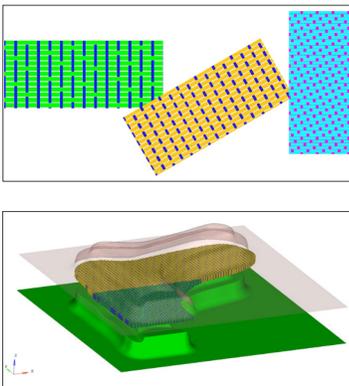


Scope

The aim of this study is to simulate the manufacturing process of an automotive composite wishbone. It has been designed to replace a steel wishbone and its composition (number of plies, geometry of plies, and orientation of fibers...) is an entry parameter of this study. The FE models of the different fabrics composing the wishbone was done with KTex Pattern inside HyperMesh. The manufacturing process simulation was set up with KTex LayUp, also inside HyperMesh and was run with RADIOSS solver.

Fabric FE Model

The composite wishbone is composed of three different fabrics. The first one is a satin weave, the second one is an interlock and the third one is a des-interlock. It is possible to build mesoscale FE models of these fabrics thanks to KTex Pattern and adapted interlacement maps. These interlacement maps describe the path followed by each yarn and how they are weft together. Many classic weaves already exist in KTex Pattern but bespoke weave can also be created, freeing the imagination of the user. Here, fabrics are well-known leading to easy-to-build FE models. Two of the fabrics need to be merged as one of the plies is a combination of two weaving patterns. This is easy to perform using HyperMesh. Once the fabrics are available, they need to be cut in the exact same shape as the real fabrics used to manufacture the part. Here again, it is an easy operation with the help of a new functionality of KTex Pattern allowing to use a custom geometry line as the base geometry for the mesoscale fabric.



Molding Simulation

When all of the plies are created with the correct weaving pattern and dimensions, they only need to be stacked as initially stacked in the real mold. Of course, the real mold needs to also be meshed in HyperMesh. Then, KTex LayUp automatically generates the counter-mold, the interfaces between the plies and the mold, and the load collectors of the manufacturing simulation (boundary conditions, velocities...).

Comparison to Reality

The user only needs to export the model and run the calculation in order to view the results, which are similar to reality. Indeed, some particular fibres have been observed and their final position after simulation is very close to the same fibres in the real final part. Some angle measurements have been performed on both the experimental part and the simulated one. This shows how KTex Family modules can be used to predict the impact of the manufacturing process and eventually optimize it.

