63. FUTURE APPROACHES TO COMPOSITE MATERIAL MODELING FOR INDUSTRIAL APPLICATIONS

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SUMMARY

The application of materials in modern composite designs faces increasing complexity. Tailored materials must meet certain targets for specific performances. Especially in the context of lightweight construction, reinforced plastics are more and more used to serve the needs. Additional difficulty arises from the fact that the performance of these materials depends on their conditioning in the processing step of the final part.

From this situation a strong need exists to understand composite materials in-depth with respect to their final performance in the part. As significant influence arises from the microstructure level which is very difficult to directly access and control via experimental approaches, multi-scale simulations are needed. For being able to efficiently design composite parts, a multi-scale material model must describe as correctly and physically as possible the final performance based on their microstructure. Still, to be usable in an industrial context, this has to be implemented in an efficient way.

A generic approach to multi-scale material modeling will be proposed which is based on commercial software and serves the purpose to deliver to the above described needs. Starting with in-depth investigations on the microscopic level, major influences on the composite properties can be identified. These effects then are implemented in material models based on mean field homogenization. Whereas the developed model is thus set up as physical as possible, a reverse engineering strategy then assures that the experimental behavior of the real material is mirrored well. The resulting simulation model can be coupled to output of processing simulations to take into account the influence of manufacturing.

The overall strategy will be presented for application cases for reinforced plastics with short and continuous type of fibers. Examples will be shown that cover material performances in stiffness, creep, failure and fatigue.