Efficient Simulation of Short Fibre Reinforced Composites

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Lightweight structures became more and more important over the last years. One special class of such structures are short fibre reinforced composites, produced by injection moulding. To avoid expensive experiments for testing the mechanical behaviour of these composites proper material models are needed. Thereby, the stochastic nature of the fibre orientation is the main problem.

In this talk we look onto the simulation of such materials in a linear thermoelastic setting. So, we use the stress-strain relation

$$\sigma = \mathfrak{C} : (\varepsilon - (\theta - \theta_0)\mathbf{T}),$$

with a fourth order material tensor $\mathfrak{C}$, a second order thermal expansion tensor $\mathbf{T}$, the temperature difference $(\theta - \theta_0)$, and the second order linearised strain tensor ε. The temperature field θ within this equation is described by

$$-\nabla \cdot (\kappa \cdot \nabla\theta) = \Theta,$$

whereas θ_0 describes a reference field. In the last equation κ describes the heat conduction and is a symmetric second order tensor.

In both equations the material properties (κ, $\mathbf{T}$, and $\mathfrak{C}$) depend on the stochastic fibre orientation. Thereby, the classical approach is to average these quantities and solve the above equations with the averaged expression. We will present a way how this approach can be extended to achieve better approximations of the solutions. For this setting we will present some numerical results.

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