Adaptive Spline Technologies for Aircraft Engine Design

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Industrial products are usually designed within Computer Aided Engineering (CAE) systems based on the B-spline technology and its non-uniform rational extension (NURBS). To overcome the limitations of their tensor-product structure, we invested in the industrial integration of recently developed generalizations: The truncated hierarchical B-splines (THB-splines) and the patchwork B-splines (PB-splines). The talk will give an overview about the aircraft engine design process at MTU Aero Engines AG and its use of the new spline technologies. First, for an adaptive surface fitting framework to reconstruct CAD models from (optical) measured point data where they lead to significant improvements with respect to the quality of the resulting geometric shape compared to the existing tensor-product spline technology. This enables us to transfer automatically the shapes of manufactured and operated parts back into the CAE systems. Second, for the exact lofting of B-spline curves by using the highly efficient structures of patchwork B-splines in the definition of the blade geometries. Third, we use the adaptive technology for the simulation-based deformation of CAD models which solves the the fundamental engine design problem of optimizing the parts for performing in hot working conditions while a cold, unloaded CAD model is required for manufacturing.