Finite element methods with B-splines

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Abstrak

The finite element method (FEM) has become the most widely accepted general-purpose technique for numerical simulations in engineering and applied mathematics. Principal applications arise in continuum mechanics, fluid flow, thermodynamics, and field theory. In these areas, computational methods are essential and benefit strongly from the enormous advances in computer technology. B-splines play an important role in approximation and geometric modeling. They are used in data fitting, computer-aided design (CAD), automated manufacturing (CAM), and computer graphics.
Finite Element Methods with B-Splines describes new weighted approximation techniques, combining the computational advantages of B-splines and standard finite elements. In particular, no grid generation is necessary, which eliminates a difficult and often time-consuming preprocessing step. The meshless methods are very efficient and yield highly accurate solutions with relatively few parameters. This is illustrated for typical boundary value problems in fluid flow, heat conduction, and elasticity.
Topics discussed by the author include basic finite element theory, algorithms for B-splines, weighted bases, stability and error estimates, multigrid techniques, applications, and numerical examples. The text is essentially self-contained and easily accessible to graduate students in mathematics, engineering, and computer sciences. The new concepts are also of interest to academic researchers and to scientists in industry who are developing finite element software. Some basic facts on functional analysis and partial differential equations, which are required, are listed in the appendix.