Multiresolution Methods in Scattered Data Modelling

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This application-oriented work concerns the design of efficient, robust and reliable algorithms for the numerical simulation of multiscale phenomena. To this end, various modern techniques from scattered data modelling, such as splines over triangulations and radial basis functions, are combined with customized adaptive strategies, which are developed individually in this work. The resulting multiresolution methods include thinning algorithms, multi levelapproximation schemes, and meshfree discretizations for transport equa tions. The utility of the proposed computational methods is supported by their wide range of applications, such as image compression, hierarchical sur face visualization, and multiscale flow simulation. Special emphasis is placed on comparisons between the various numerical algorithms developed in this work and comparable state-of-the-art methods. To this end, extensive numerical examples, mainly arising from real-world applications, are provided. This research monograph is arranged in six chapters: 1. Introduction; 2. Algorithms and Data Structures; 3. Radial Basis Functions; 4. Thinning Algorithms; 5. Multilevel Approximation Schemes; 6. Meshfree Methods for Transport Equations. Chapter 1 provides a preliminary discussion on basic concepts, tools and principles of multiresolution methods, scattered data modelling, multilevel methods and adaptive irregular sampling. Relevant algorithms and data structures, such as triangulation methods, heaps, and quadtrees, are then introduced in Chapter 2.

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