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Computing with Hp-Adaptive Finite Elements, Vol. 1: One and Two Dimensional Elliptic and Maxwell Problems

Leszek Demkowicz

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Offering the only existing finite element (FE) codes for Maxwell equations that support hp refinements on irregular meshes, Computing with hp-ADAPTIVE FINITE ELEMENTS: Volume 1. One- and Two-Dimensional Elliptic and Maxwell Problems presents 1D and 2D codes and automatic hp adaptivity. This self-contained source discusses the theory and implementation of hp-adaptive FE methods, focusing on projection-based interpolation and the corresponding hp-adaptive strategy.

The book is split into three parts, progressing from simple to more advanced problems. Part I examines the hp elements for the standard 1D model elliptic problem. The author develops the variational formulation and explains the construction of FE basis functions. The book then introduces the 1D code (1Dhp) and automatic hp adaptivity. This first part ends with a study of a 1D wave propagation problem. In Part II, the book proceeds to 2D elliptic problems, discussing two model problems that are slightly beyond standard-level examples: 3D axisymmetric antenna problem for Maxwell equations (example of a complex-valued, indefinite problem) and 2D elasticity (example of an elliptic system). The author concludes with a presentation on infinite elements - one of the possible tools to solve exterior boundary-value problems. Part III focuses on 2D time-harmonic Maxwell equations. The book explains the construction of the hp edge elements and the fundamental de Rham diagram for the whole family of hp discretizations. Next, it explores the differences between the elliptic and Maxwell versions of the 2D code, including automatic hp adaptivity. Finally, the book presents 2D exterior (radiation and scattering) problems and sample solutions using coupled hp finite/infinite elements.

In Computing with hp-ADAPTIVE FINITE ELEMENTS, the information provided, including many unpublished details, aids in solving elliptic and Maxwell problems.

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