数学与系统科学研究院

计算数学所定期学术报告

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报告题目：

C0 elements for computational electromagnetism

邀请人：　谢和虎副研究员

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报告地点：　科技综合楼三层 **311**

计算数学所报告厅

Abstract:

I will talk about the application of C0 elements for computational magnetism. As is well-known, electromagnetism is governed by curl and div operators. A natural finite element method for this type of curl-div equations should be C0 element method, since both curl and div conforming piecewise polynomial approximations are necessarily H1 conforming and are thus C0 elements. However, it is by no means seemingly correct for C0 elements in solving curl-div equations. In fact, it had been for more than half a century no advances were known about whether C0 elements could be employed for the curl-div equations or not. A well-known fact had been that C0 elements failed whenever the domain is nonsmooth with reentrant corners and edges or whenever the solution is nonsmooth and does not belong to H1 space. Until 2002, a breakthrough was made by Costabel and Dauge, with a weighted-regularization method for Maxwell's equations. Since then, several new variants and new C0 element methods have been developed. The new variants of the weighted regularization C0 element methods are two. Jr. Ciarlet and his research group study a weighted regularization mixed C0 element method. T. Manteuffel and his research group study a weighted least-squares C0 finite element method for first-order system. Beside the weighted regularization C0 element method, the new C0 element methods are also two. J. Bramble and his research group propose a minus one norm based least-squares C0 finite element method for first-order system. H. Duan and his research group propose and develop a L2 projected C0 element method for any curl and div equations including second-order and first-order systems. J.-L. Guermond and his research group study a variant of the minus one norm based C0 element method for curlcurl-div equation by applying the minus one norm to measure the first-order div equation like in the first-order system. C0 element methods are very attractive, especially when applied to magnetohydrodynamic where Navier-Stokes equations are coupled with Maxwell's equations, since all the unknowns can be approximated using the same type of C0 elements. In the form of first-order system, C0 elements are particularly useful, one mesh, one element, one code and one algorithm for all matters in computer realization. In this talk, several numerical examples will be given to illustrate our L2 projected C0 element methods for curl and div equations related to Maxwell's equations. In conclusion, so far, there are three C0 element methods, 1) weighted C0 element method; 2) H^{-1} C0 element method; 3) L2 projected C0 element method.

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