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BOOK REVIEW

Matrix Preconditioning Techniques and Applications. By K. CHEN. Cambridge University Press, 2005. 592 pp. ISBN 0521 83828 2. £55.

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Preconditioning is a miscellaneous bag of tricks, the vital component of an effective solver or a completely frustrating area in which to dabble depending on who you ask. In a sense it is all of these things: and herein lies the difficulty of constructing a monograph on the subject. For each different application a preconditioner can be the enabling component, make no difference at all or even make matters worse (if it is a pre-de-conditioner!). A good preconditioning book not geared to a particular application area is therefore hard to write.

In this book (in the excellent Cambridge Monographs on Applied and Computational Mathematics series) Chen has done an admirable job in this context. The last 120 of its 500 or so pages give workable descriptions and very useful pointers to computer codes for different application problems: acoustic scattering, coupled problems, image restoration and electrical power systems. This is followed by a very brief chapter on 'Parallel computing by examples' – the author really has decided to put in what must be most of the things he knows! The first 65 pages of the introductory chapter are also packed with material: matrix norms and perturbation theory, Arnoldi's method, the field of values and ϵ-pseudospectrum, fast Fourier and fast wavelet transforms, finite elements, finite differences, boundary elements, finite volumes, global elements, so there is little chance that at least something connected to a practical application is not covered!

It should be noted that convergence theory is de-emphasised, indeed the author says that '[convergence] theories, while useful and mathematically interesting, are not always relevant to faster iterative solution': if you are interested in these aspects, look elsewhere.

The remaining chapters cover direct and iterative methods, matrix splitting (incomplete LU-type) preconditioners, approximate inverses, multilevel methods (yes, there are nonlinear and algebraic multigrid algorithms here also!... for differential and integral equations), Schur preconditioners and finally the work for which the author is most well known: wavelet preconditioners.

Chen has done a good job in providing MATLAB software for most of the methods covered and indicating where other software can be found. At the end of each chapter is a list of typically 10 or so specific MATLAB m-files which are all freely downloadable from the author's website.

A curiosity for which the publishers must be responsible is the cluster of colour figures on the 8 pages between pages 288 and 289: this looks so anachronistic and yet is so widespread in scientific publishing. When will publishers/printers get the message that in many circumstances such as here, the exact colours of things are not crucial so long as there are *different* colours so that the reader can discriminate. As soon as this is realised, the idea of having colour figures spread throughout a book should become easy.

In summary this book is packed with mathematical description relevant for various types of preconditioning for (in particular) non-symmetric matrix equations. It could be of considerable use in introducing applications scientists to possible preconditioning approaches.

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