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K-DIMENSIONAL MATRICES IN NUMERICAL SOLUTION OF DIFFUSION PROBLEMS

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ABSTRACT The numerical methods useful for partial differential equations (PDEs) solutions present a continuous improvement. The reason of these continuous changes mainly depends on hardware computer development. Nowadays, it is possible to solve really complex models obtaining fair detailed solutions. Usually for numerical solutions of PDE are employed finite methods that approximate PDEs by means of algebraic equations.

If PDEs and the boundary conditions are linear, the algebraic equations, corresponding to the employed finite methods, is linear too. The system matrix obtained solving the PDE by the finite techniques is sparse, sometimes non-symmetric, but topological symmetric. Several papers are related to the solution of sparse linear systems. Numerical algorithms employed for the solution of linear equation systems are direct and iterative methods. Usually iterative approach in the linear system derived by finite methods in PDE numerical solution is preferred. In the following it is referred to linear PDEs that describe diffusion phenomena either parabolic or elliptic problems.

In this paper, a generalization to N-dimensions of the tridiagonal matrix algorithm as given by Thomas is proposed. The K-dimensional matrices, as defined in Manca (1979), to generalize the method are employed. The correspondence between the spatial dimension of the problem and the dimension of this kind of matrix structure is proved. The proposed method allows to solve multidimensional problems for partial differential equations with a number of independent variables n greater than 4. It extends the Thomas algorithm to any dimensions in the sense that the tridiagonal concept is generalized to a tridiagonal structured matrix where each matrix can be a matrix and so on.

Manca R. Matrici a più dimensioni [K-dimensional Matrices], *Quaderno n.23 dell'Istituto di Matematica della Facoltà di Economia e Commercio dell'Università di Napoli* (1979).