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# Deriving a System of Linear Algebraic Equations Using the Monte Carlo Method

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**Abstract:** In the article, to bring the system of linear algebraic equations, it is necessary to choose such a numbering order that it forms a group of non-zero elements of the matrix.

The use of the Monte Carlo method leads to a system of linear algebraic equations. To solve the system of equations, the modified square root method is used for the symmetric ribbon structure of the coefficient matrix since each finite element is connected with a finite number of other finite elements; the matrix of the system of equations is always sparsely filled. The location of the coefficients in the matrix is closely related to the numbering order of the nodes in the body.

With random numbering, the non-zero components in the matrix are also randomly distributed, and this, in turn, leads to an increase in the calculation time of the problem.

Therefore, it is necessary to choose such a numbering order, in which non-zero elements are grouped near the main diagonal of the matrix, that is, they form a line (ribbon).

The order of node numbers in the discrete model allows to minimize the width of the tape of non-zero coefficients of the equation solving system. Since the coefficients of the matrix of such a system of equations and the coefficients of the stiffness matrix of finite elements are symmetric, at the stage of solving the system of equations only it is advisable to use diagonal elements and elements. The lower triangular matrix is calculated below it.

In this case, the coefficients of the last matrix also have a band structure. Since the transformation of the square root method mainly uses the matrix-to-vector operation, it is necessary to develop a matrix-to-vector algorithm for the case where only the coefficients of the lower row of the triangular matrix are used.

if these coefficients are arranged in a row, a rectangular matrix with dimensions $S_{ij}$ is formed, where n is the order of the system of equations, l is non-zero coefficients If these coefficients are arranged in a row, a rectangular matrix with dimensions $S_{ij}$ is formed, where n is the order of the system of equations, l is non-zero coefficients.

Including half the width of the tape. diagonal elements. Moreover, the diagonal elements of the original matrix are located in the last lth column of the Sij matrix.

To illustrate the changes, let's assume n=9, l=4. In this case, the lower triangular and rectangular matrices Sij have the following forms.

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$$T' = \begin{bmatrix} t_{11} & & & & & & & & \\ t_{21} & t_{22} & & & & & & & \\ t_{31} & t_{32} & t_{33} & & & & & & \\ t_{41} & t_{42} & t_{43} & t_{44} & & & & & \\ 0 & t_{52} & t_{53} & t_{54} & t_{55} & & & & \\ 0 & 0 & t_{63} & t_{64} & t_{65} & t_{66} & & & \\ 0 & 0 & 0 & t_{74} & t_{75} & t_{76} & t_{77} & & \\ 0 & 0 & 0 & 0 & t_{85} & t_{86} & t_{87} & t_{88} & \\ 0 & 0 & 0 & 0 & 0 & t_{96} & t_{97} & t_{98} & t_{99} \end{bmatrix} \qquad S = \begin{bmatrix} 0 & 0 & 0 & s_{14} \\ 0 & 0 & s_{23} & s_{24} \\ 0 & s_{32} & s_{33} & s_{34} \\ s_{41} & s_{42} & s_{43} & s_{44} \\ s_{51} & s_{52} & s_{53} & s_{54} \\ s_{61} & s_{62} & s_{63} & s_{64} \\ s_{71} & s_{72} & s_{73} & s_{74} \\ s_{81} & s_{82} & s_{83} & s_{84} \\ s_{91} & s_{92} & s_{93} & s_{94} \end{bmatrix}$$

**System of coefficients of equations.**

To form the process of multiplaying the matrix sij by the vector xj, the following relation is developed and applied, based on the modified coefficients located diagonally and below the matrix:

$$y_i = \sum_{j=1}^{p} s_{i,q} x_r + \sum_{j=i}^{m} s_{j,i+l-j} x_j$$

$$p = \begin{Bmatrix} i-1, 1 \le i \le l \\ l-1, \text{èíà÷å} \end{Bmatrix} \quad q = \begin{Bmatrix} l+j-i, 1 \le i \le l \\ j, \text{èíà÷å} \end{Bmatrix} \quad r = \begin{Bmatrix} j, 1 \le i \le l \\ i-l+j, \text{èíà÷å} \end{Bmatrix} \quad m = \begin{Bmatrix} i+l-1, 1 \le i \le n-l+1 \\ n, \text{èíà÷å} \end{Bmatrix}$$

The above relationship makes it possible to perform in the algorithm of the method of square roots without zero coefficients and without coefficients of the upper triangular matrix outside the zone of non-zero elements using the corresponding diagonal coefficients and coefficients of the lower triangular matrix.

**literature**

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