Using of Parallel Computing for the Quasi-static Analysis of Microstrip Filters Topology

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Abstract – **An algorithm for calculation of multiconductor microstrip devices implemented on a substrate with slots in the ground plane using a quasi-static methods has been developed. Analysis of techniques for constructing a parallel algorithm for finding the inverse matrices for quasi-static calculation of microstrip filters was carried out.**

Keywords – **FORTRAN, Inverse matrix, Gauss-Jordan elimination method, Parallel computing, Microstrip passband filter.**

I. Introduction

Schemes calculation of multiconductor microstrip devices is implemented in many modeling systems. At that simulation is performed in real time, because of what high demands of productivity software are made. In the issue using of parallel information technology modeling process can be significantly accelerated resulting expenditure of time and labor expenses for the microwave devices development will be reduced considerably.

II. Calculations and modeling

The purpose of this paper is time reduction of the quasi-static analysis of the microstrip filters topology. It is necessary to analyze quasi-static calculation algorithm to find a way to build parallel algorithm. In the general case, analysis should be performed the algorithm graph and the problem of the parallel algorithm mapping on a multiprocessor computer system architecture must be solved. The ability of the algorithm to parallelization potentially is related to one of two internal properties which are characterized as task parallelism and data parallelism. If the algorithm is based on task parallelism, the computational task is divided into several relatively independent subtasks [1]. If there are data parallelism properties in the algorithm, one operation can be performed simultaneously on all elements of the array data.

In this paper, an algorithm of the multiconductor microstrip devices calculation, using quasi-static methods has been developed. One of this algorithm items is the calculation of the microstrip lines impedances. These values in its turn determined on the basis capacitance matrices which were obtained by quasi-static analysis of the topology microstrip passband filter on hairpin resonators [2]. At the same almost linear order of the operations implementation on large data arrays has been observed in the algorithm. From this we can conclude that there is data parallelism in the algorithm. Parallel algorithm may be applied to the program section for the creation of a matrix of cells' coordinates and the initial coordinates of the analyzed regions, as well as to finding the matrix of coordinates of midpoints and widths cells.

However, application of a parallel algorithm is most effective when finding of the capacitance matrix which is amounted to finding the inverse matrix by Gauss-Jordan elimination method. In the developed algorithm this process takes 94% of the operation time of the program as a whole. The dimensionality of the square matrix in the calculations can be up to 5000x5000 cells and more. When calculating parallelization of the inverse matrix by Gauss-Jordan elimination method should be considered that common to all streams calculated coefficients are used at the each iteration. Therefore incorrect parallelization can lead to "data race" and consequently to the wrong end results.

III. Conclusion

Based on the performed analysis parallel algorithm of program operation for the quasi-static calculation of the multiconductor microstrip devices' topology has been developed. To evaluate the quality of the parallel algorithm acceleration performance and efficiency have been used [1]. Accelerations of the developed algorithm for an array 1000x1000 is 1.46, for an array 1500x1500 is 1.4, for an array 2000x2000 is 1.64.

References

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