IOSUD - Universitatea Politehnica Timişoara
Şcoala Doctorală de Studii Inginereşti

DATA DISTRIBUTION SCHEME IN CASE OF THE HIGH PERFORMANCE PARALLEL NUMERIC SIMULATIONS APPLIED FOR THE WIND SYSTEMS CONTROL AT VARIABLE WIND SPEED

PhD Thesis – Summary

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The researches regarding the wind energy field refer to the wind systems control at constant wind speed as well as to the wind systems control at variable wind speed such as the Romanian real case. At variable wind speed, the wind systems control involves problems related to the wind speed variation, which are described by the large ordinary differential equations whose serial solution, by using numerical simulation, requires large solving time.

All the achieved numerical simulations are based on mathematical models, which describe the physical phenomena, but which are time consuming involving some parallel solving methods proposed by using a multicore system, in order to reduce the serial solution time.

In case of the variable wind systems control, the author has been identified some important problems related to the wind speed variation, and also, he has been proposed some mathematical models for wind turbine and permanent-magnet synchronous generator, as well. These models allow obtaining of the mechanical angular speed for which the maximum wind energy is achieved, and simulating several working modes, as well. Based on the obtained results, the author has been proposed several control structures that have been tested considering real problems from wind energy field.

Furthermore, the author has been proposed parallel solving methods for a quad-core parallel structure that have been verified on real wind energy problem in order to highlight their efficiency. These methods are based on data parallelism by using a proposed parallel structure called quad-parallel structure, and their background consist in reducing the solving time.

The exponential growth of the computer's performance offers the possibility of reducing the time required by large simulations. On the other hand, the large simulations involve working with large datasets. This was the reason for which the author has been proposed a data-distribution scheme used for distributing of a large dataset (i.e. a large simulation interval is broken in many simulation subintervals, on which a parallelizable portion of code will be simulated) across a parallel computing system like a multicore system. In order to analyze the data flow on the proposed parallel structure, the author has been defined a data-flow diagram.

All contributions achieved and showed in this thesis where verified by solving many real wind energy field.