Open research issues on Modeling, Simulation and Optimization in Electrical Systems

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Abstract - We are going to present here a number of results on open research issues in the area of Modeling, Simulation and Optimization in Electrical Systems. The results range from methodologies to applications and include: power quality problems in electronic converters, control of power in complex computing environment, optimization methods for power control systems.

Keywords - Modeling and simulation of electrical systems and machines, Modeling and simulation of power electronics.

Introduction

The special Issue "Modeling, Simulation and Optimization in Electrical Systems" intends to collect original unpublished papers, aiming theoretical and practical matters, dealing with recent trends of Modeling, Simulation and Optimization in Electrical Systems.

The power quality problems are generated by many applications of static power electronic converters, fluorescent lamps, arc furnaces and so on. One of the papers from this special issue studies the current harmonic spectrum generated by functioning of an electrothermal installation with electromagnetic induction. In order to analyze the electrical parameters that characterize the electrothermal installation functioning, measurement sets were accomplished using two methods. The first method consists in using a power and energy quality analyzer and the second method uses an acquisition system that contains an adapting interface and a data acquisition board connected to a computer. Paper contains also a simulation of the electrothermal installation functioning realized in PSCAD-EMTDC.

The proliferation of nonlinear electronic loads is increasing day by day, and it can anticipate an influx of newer technologies in this domain in the future. Another article focuses on the impacts of various home nonlinear electric equipment on the power quality of electrical distribution system. It was studied the influence of operating mode on the harmonic pollution generated by nonlinear home appliances operating in an isolated mode, using the *CA 8334B* three-phase power quality analyzer. Although home electric appliances are low power receivers, the cumulative effect produced by a large number of small harmonic sources can be substantial.

Cloud *computing*, as a new model of service provision in distributed computing environment, faces the great challenge of energy consumption because of its large demand for computing resources. Choosing improper scheduling method to execute cloud workflow tends to result in the waste of power consumption. In order to lower the higher power consumption for cloud workflow executing, we propose a power consumption optimization algorithm for cloud workflow scheduling based on SLA (Service Level Agreement), which can reduce power consumption while meeting the performance-based constraints of time and cost. The algorithm first searches for all feasible scheduling solutions of cloud workflow application with critical path, then the optimal scheduling solution can be found out through calculating total energy consumption for each feasible scheduling solution. The experimental results show that compared with traditional workflow scheduling algorithms based on QoS, the optimization algorithm proposed in this paper not only meets the constraints of time and cost defined in SLA, but also reduces the average power consumption by around 10%.

In one of the papers, the assessment of new coordinated design of Power System Stabilizers (PSSs) and Static Var Compensator (SVC) in a multimachine power system via statistical method is proposed. The coordinated design problem of PSSs and SVC over a wide range of loading conditions is handled as an

optimization problem. The Bacterial Swarming Optimization (BSO), which synergistically couples the Bacterial Foraging (BF) with the Particle Swarm optimization (PSO), is employed to seek for optimal controllers parameters. By minimizing the proposed objective function, in which the speed deviations between generators are involved; stability performance of the system is enhanced. To compare the capability of PSS and SVC, both are designed independently, and then in a coordinated manner. Simultaneous tuning of the BSO based coordinated controller gives robust damping performance over wide range of operating conditions and large disturbance in compare to optimized PSS controller based on BSO (BSOPSS) and optimized SVC controller based on BSO (BSOSVC). Moreover, a statistical T test is executed to validate the robustness of coordinated controller versus uncoordinated one.

Conclusions

Harmonic analyzing is very necessary for designing the electronic devices which must compensate the distorted regime introduced into the power system by the nonlinear loads. Using PSCAD-EMTDC simulations of the electric equipments functioning can be accomplished. So, the command and control elements for the electrothermal installation were modeled. The PSCAD EMTDC is able to display the variation of the current harmonics. Acquisition with CA8334B power analyzer represents a very practical method for studying in real time of the electrical parameters variation.

Most of the nonlinear electric equipment highly distorted current waveforms which produces high levels of harmonic distortions when connected to a distribution system. *SMPS* is present in almost all home and commercial nonlinear loads, such as computers, monitors, laptops, electronic ballasts for fluorescent lamps, etc. From all house nonlinear electric equipment, these type of loads show the most current harmonic distortion. *SMPS*'s current has a significant amount of multiply 3^{rd} harmonics order (3^{rd}, 9^{th}, 15^{th}, etc.). These harmonics add algebraically through neutral conductor. So, in three-phase power systems that have a neutral conductor and a large number of single-phase *SMPS* loads, even if the loads are balanced (on the three phases), will circulate an important neutral current, that can not be eliminated or reduced.

Current harmonic distortion is influenced by operation mode for almost analysed nonlinear loads, with the exception of the microwave oven.

Induction heat plate generates harmonics only in stand-by mode, the laser printer only in idle mode and the air condition devices, especially in stand-by mode. Due to the nonlinear electronics equipment show that harmonic voltage distortion is up 4.9 %.

The cumulative effect produced by a large number of small nonlinear electric equipment (harmonic sources) can be substantial, because the total harmonic distortion current (THDI) can reach up to 130% at the terminals of these electric loads, generating additional power and energy losses in electric networks.

Through analyzing the energy computing model for cloud workflow execution, we have proposed an energy consumption algorithm of cloud workflow scheduling under the constraints of time and cost in SLA. Simulated experiments demonstrate that this optimization method is fully effective and feasible. But the energy optimization issue isn't implemented in the virtual cloud environment. So, we will further investigate the energy consumption optimization of cloud workflow scheduling based on the virtual machines allocation in the future, and carry out experiments in real virtualization cloud platform so as to ensure the correctness and effectiveness of research result

The statistical assessment of the robust coordinated design of PSSs and SVC damping controller in a multimachine power system is proposed in this paper. The design problem of the proposed controller is formulated as an optimization problem and BSO is employed to search for optimal controller parameters. By minimizing the time domain objective function, in which the deviations in speed are involved; stability performance of the system is improved. Simulations results assure the effectiveness of the proposed coordinated controller in providing good damping characteristic to system oscillations over a wide range of loading conditions and large disturbance. Moreover, it is superior to uncoordinated controller through the statistical assessment.

Finally before diving into the collected research works [17-21], let us remember the reader that WSEAS Transactions on Systems has been hosting and will continue to do so a few Special Issues in the latest years [1-20]. This is has the objective of creating an active and contributing research community around the journal and to present their latest efforts which have achieved wide interest among its members. As a reader of the journal you are invited to take inspiration by the presented papers and to consider to submit your future works to the journal itself.

Enjoy your reading!

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