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Abstract

THE HYBRID REAL-TIME SIMULATION SYSTEM  
BASED ON THE ELECTROMECHANICAL TRANSIENT  
PROCESS IN POWER SYSTEM

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Whether the power system can perform well is very important to the national economy and people's daily life. With the development of society, the scale of power grid is getting larger and larger. Power system simulation is an important tool to research in the field of modern science and engineering of power system. To research the more complex problem of larger power system, the requirement of power system simulation is becoming higher. Many popular simulation tools used today are off-line. They are widely used in planning, designing and validating power system. However, with the continuing involvement of HVDC and FACTS technologies, the off-line simulation has more and more difficulties in satisfying the requirement of scientific research and engineering application. So, on-line real-time simulation has been becoming the focus of research nowadays. Real-time simulation always involves physical devices and leads to a software and physical hybrid simulation. There are several real-time hybrid simulation systems available. They have their advantages and disadvantages. High cost and great complexity are two main disadvantages in the current real-time hybrid simulation systems. This thesis proposes a real-time hybrid simulation system based on the electromechanical transient process simulation. In the proposed real-time hybrid simulation system, physical devices can be tested in large power system in a simple way with low cost.

The chapter 1 is the introduction to this thesis.

The chapter 2 proposes the configuration of a hybrid real-time simulation system based on the electromechanical transient process simulation. The simulation system includes three parts: the electromechanical transient process simulation; the physical devices; the interface device. The chapter 2 also develops the interface program of the electromechanical transient process simulation using single thread configuration. It develops the digital signal processing program to manage the communicating data between the electromechanical transient process and the physical devices.

The chapter 3 tests the simulation system using the excitation controller in closed loop experiment. It tests the simulation system using the relay protector in closed loop experiment. The results of the experiments show that the hybrid simulation is almost the same as the software simulation through the comparison of the experimental results.

The chapter 4 researches the feature of real-time of this hybrid simulation system. Test the communication time to determine the allowable calculation time on this hybrid simulation system. The testing results show that the simulation system can match the requirement of real-time. The allowable calculation time is given out. However, refer to the restricted real-time simulation, the real-time operation system should be employed.

The chapter 5 discusses some critical technologies to construct a more advanced and complex hybrid simulation system including the electromechanical, electromagnetic simulation and physical devices. It discusses the selection of hardware of interface device. The PXI with memory mapping card is recommended after the discussion of the chapter 5.