SECURITY ASSESSMENT
OF POWER SYSTEMS
INCLUDING ENERGY STORAGE

Progress Report
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MASTER

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CONTRACT ACTIVITY

The portion of contract supervised by D.P. Carroll has terminated, and he has not participated in contract activity during the past quarter. D.M. Triezenberg will continue at 25% during the next quarter.

ABSTRACT

A parameter estimation algorithm has been found which, theoretically, is capable of on line operation. It has been implemented and the implementation has been confirmed by performance on simple first and second order systems. However, convergence has not been obtained for higher order systems.

POWER SYSTEM IDENTIFICATION

This progress report concerns identification of power system electromechanical models from system measurements, with only normal load variation as a disturbing input. Previous progress reports have also covered the activity in energy storage applications, but this activity has now ceased, as scheduled.

Instrument Variable Algorithm

In the previous progress report, an algorithm was discussed (the instrument variable algorithm) which is theoretically capable of estimating the AR parameters of a general ARMA process when only the output time series is available. The algorithm was implemented in a form suitable for single output systems, and an example of the performance in estimation of second order system parameters was given.

Study of this algorithm has continued. It has been implemented in a form suitable for multiple output systems. Both implementations appear to be error free, as they converge first and second order systems. But convergence has not been obtained for higher order systems, in particular, on an output time series produced by a simulated power system with two machines and an infinite bus.

The investigator suspects that the power system electromechanical model is a particularly difficult case, as a large portion of the load fluctuation appears directly in the measurements. That is, in the system equations

$$x_{k+1} = Ax_k + Bw_k$$

$$y_k = Cx_k + Dw_k$$

the term Dw_k can dominate over Cx_k in forming the output y_k . This undoubtedly makes identification of the matrix A (regardless of canonical form) difficult.