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Mr. Robert Brill
U.S. Nuclear Regulatory Commision
Nicholson Ln.
Washington, D.C., 20555

SUBJECT: Bi-Monthly report on USNRC Grant NRC-04-93-089

Dear Mr. Brill:

The following paragraphs describe the progress on grant NRC-04-93-089 for the period 1 March to 30 April, 1994.

During this period, the project focused on satisifaction of Part iii of the Project Outline; Formalization and Encoding of the Information Structure of a system using Neural Technology. The ancillary objective was to develop the technical background and capability of C.J. Parisi. These tasks were accomplished:

i) A FORTRAN developmental environment was created. The environment, called PWB, was installed on an i486 platform. It mechanizes the code development cycle.

ii) A second order linear system L_2 was coded using PWB, and a time series of 10,000 data sets was constructed.

iii) The effect of digital noise on the resolution of fault detectors given perfect state information was characterized.

A tandem Multi-Linear Perceptron (MLP) was coded, and, using perfect state information, applied as a Null-State Detector (NSD). Because the structure of the system L_2 is known exactly and because all state information is available, a MLP can be constructed *a priori*. The MLP was structured as a NSD, which outputs a zero vector whenever a datum of the time series exactly represents a state transition of L_2. In general, however, the output is corrupted by noise due finite precision. These results show that effect of digital noise on the NSD can be characterized by an uniform probability distribution.

iv) The effect of low-order state information on the resolution of fault detectors was characterized.

Interesting systems, such as turbine control valves (TCV's), are usually of high order and are nonlinear. On the other hand, a desirable property of fault detectors is that they be of low order, and must function using low-order state information. To characterize this effect, a pre-NSD filter used to provide estimates of the higher order states of L_2. The

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filter provided two estimates; one using a system model and another obtained through differentiation. A unique estimate was generated by taking a weighted average of the two. In general, the model based estimate resulted in a digital noise spectra with a snmaller standard deviation.

To complete the basis of the information structure for continous time systems, the effects of measurement and system noise for a compact non-linear systems will need to be considered within the same context. After the basis for compact systems is in place, it will be necessary to develop the information structure of a digitally controlled system.

It is anticipated that by the end of July these tasks will be completed.

If there are any suggestions, questions, or concerns, please call.

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