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by

Y. C. Ho

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FINAL REPORT FOR
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by

Y. C. Ho

The principal investigator spent the academic year 1977-78 visiting the Electronic Systems Laboratory of M.I.T. and doing research in the area of Information in Large Systems. Three specific topics are investigated.

1. Decentralized Control, Signaling, and Real Time Information Theory.

In centralized control, a decision maker is concerned with two effects of his decisions or controls: (i) direct impact of the decision on the payoff, (ii) indirect impact of the decision on the payoff by allowing acquisition of better information for later decisions. The tradeoff between these two desires is sometimes known as dual control. When there are more than one decision makers, a third possibility occurs, that of influencing other decision makers' information through one's action. This is signaling. The simplest case of signaling is captured by Information theory under the real time constraints (i.e. no arbitrary delays are permitted). The application and modification of classical information-theoretic results to decentralized control problems and signaling problems in economic organizations represent a difficult and wide open problem area for future investigation.

The principal investigator was an invited plenary session speaker at the 1977 International Information Theory Symposium, and an invited speaker at the Third Kingston Conference on Differential Games and Mathematical Economics. He spoke on the above topics. He also actively participated in the supervision of two Ph.D. thesis at M.I.T. in this area.

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Two papers were written and published.

2. Data Base and Large Information Systems

Conceptually, a data base appears at first glance as the embodiment of simplicity. Information are stored and retrieved automatically and systematically by straightforward computer routines. However, the sheer size of the volume of data completely destroys this simplicity. Hours of computer time may be required to locate a single piece of data. Thus organization and optimization questions naturally arise in data base management in addition to any hardware, software, and interface problems inherent in any real system. These logical and structural questions fall under the domain of system theory. They have been partially treated by computer scientists. However, it appears that system and control theorist can also make contributions.

The principal investigator spent the year mostly in understanding the issues involved in data base management theory. He also interacted with the Institute of Defense Analysis to learn about real data base systems such as the WWMCC and FORSTAT systems. He initiated two research problems in security and query optimization in DB systems. The effort will culminate in his talk, "A Control Theorist's View of Data Base in C^3 ," at the August 1978 C^3 Workshop at M.I.T.

3. Management of Large Industrial Systems

It has been clear for sometime that optimization and control problems exist in large industrial systems. However, it has also been clear that usual decision and control techniques of the $\dot{x} = Ax + Bu$ variety are not applicable to the dynamics of such systems. As vehicles for study general problems in this area, we have solved an inventory management problem in a large warehouse and a buffer storage problem in a production line.

The former involves a novel application of the Arrow-Hurwicz decomposition algorithm which in this case reduced an optimization problem involving one million variables to one of twenty-four variables! The latter is a well known problem of long standing for which we have developed an effective successive approximation technique for solution. While it is interesting to solve these specific problems, the overall objective is to discern generally applicable techniques in these systems. It appears that our solution techniques can be applied to other areas of large systems, such as file allocation in distributed computer systems, buffers and queues in networks. Efforts will be continued.

References:

1. Y. C. Ho, M. P. Kastner, and E. Wong, "Teams, Market Signaling and Information Structure," IEEE Transactions on Automatic Control, Special Issue on Decentralized Control, Vol. AC-23, No. 2, April 1978, pp. 305-311.
2. Y. C. Ho and T. S. Chang, "On Sending One Bit of Information Over an AGWN Channel with Noiseless Feedback," Journal of Optimization Theory and Applications, Vol. 27, No. 1, January 1979.
3. R. Suri and Y. C. Ho, "Resource Allocation in An Automated Warehouse," to appear in the 1978 CDC Proceedings, San Diego, California (January 7-9, 1979).
4. T. T. Chien, A. Eyler, and Y. C. Ho, "A Gradient Approach to Buffer Storage Design in a General Production Line," to appear 1978 CDC Proceedings, San Diego, California (January 7-9, 1979).