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M-1408

Quarterly Report, Contract N5ori-06002
July through September 1951

Project NR 232-001

DIGITAL COMPUTER LABORATORY

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Digital Computer Laboratory
Massachusetts Institute of Technology
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SUBJECT: QUARTERLY STATUS REPORT, CONTRACT N5ori-06002
JULY through SEPTEMBER, 1951

To: Dr. C.V.L. Smith
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From: William K. Linvill

Abstract: This report describes work performed during July, August, and September, 1951 on the extension of Contract N5ori-06002. All of the work is directed toward an analytical study of control systems involving digital computers as components.

1.0 INTRODUCTION

This is the first quarterly progress report submitted under the extension of Contract N5ori-06002 covering research performed during July, August, and September 1951 in application of digital computers to control systems. As proposed in Memorandum L-28 the research was to be directed toward:

(a) Further development of the digital computer itself.
(b) Development of suitable terminal equipment.
(c) Theoretical work investigating the behavior of a system involving a digital computer.
(d) Programming problems related to the Computer's ability to make decisions.
(e) Use of the digital computer in simulation of other equipment.

The bulk of the work done during the last quarter was directed toward (c). Work in areas (a) and (b) was done during this period at Project Whirlwind but under different contracts. Since it is more applicable to other projects than this it is not at present supported by our funds. Work in areas (d) and (e) will be done at a later date.

2.0 STATUS

The problems involved in analyzing the behavior of a system involving a digital computer arise because most components of a

system receive, operate on and transmit continuous signals. The digital computer receives, operates on, and transmits sampled (discrete) signals. Thus a system involving a digital computer is a mixed system with some parts operating on continuous signals and with some parts operating on sampled signals. If the computer interacts with the rest of the system, the analysis of both sampled-data and continuous-data parts should be carried out in the same terms.

On the basis of work done on sampled-data control systems at Project Whirlwind some time ago, sampling is comparable to amplitude modulation, desampling comparable to demodulation. Mixed systems involving partly sampled and partly continuous data may be analyzed in much the same way one would analyze an analogous but simpler mixed system involving some parts operating on unmodulated or direct signals and other parts operating on amplitude-modulated signals. A doctoral thesis[1] completed during the last quarter described all linear digital computer programs by transfer functions in the frequency domain. A master's thesis[2] done during the last quarter showed how the Wiener-Lee optimum linear system theory can by applied to digital systems. An investigation has been started on the problem of smoothing a computer output with a small phase lag in the signal. One of the unique advantages of using the computer as a control system element is derived from its ability to make choices. Work is started on describing this operation but no significant results have been obtained as yet.

Signed William K. Linvill
William K. Linvill

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References:

1. Salzer, J.M., Treatment of Digital Control Systems and Numerical Processes in the Frequency Domain, 1951, M.I.T., Sc.D. Thesis in Electrical Engineering.

2. Katz, Abraham, Computer Program Synthesis Based on Statistical Communication Theory, 1951, M.I.T., S.M. Thesis in Electrical Engineering.