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Room 7-306

November 25, 1952

Wright Air Development Center
Wright-Patterson Air Force Base
Dayton, Ohio

Att: Lt. Col. H. C. Henry, USAF (WCRR)

Subject: Contract AF33(616)-128
Expenditure Order No. R-466 BR-1

Dear Colonel Henry:

This letter is to inform you that the following report:

"Solution of Boundary-Value Problems on
Automatic Computing Equipment"

covering the work of the quarterly period ending August 31, 1952 is being mailed prepaid to the following address:

AF 909 SO
Service Area Bldg. 258
Wright-Patterson Air Force Base
Dayton, Ohio
Attn: WCRR.

I informed Dr. E. P. Little during the early part of the summer that the activity on this contract would not be initiated in full volume on June 1, 1952 because of the personnel procurement problem. This, in part, explains the delay in the submission of this first quarterly report. The other reason is simply that there are over 300 pages in the report and its preparation was an exceedingly time-consuming task. At any rate, one reproducible (a transparent ozalid) and four copies are being submitted under separate cover.

I wish to emphasize that only a portion of the work represented by this report was performed using funds of this contract. Specifically, this thesis represents several years' work, and it is only the final stages of it which were performed during this quarterly period.

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Attached you will find an abstract of this thesis report which will give you an idea of its content. I hope this will be helpful to you.

In conclusion, I wish to state that the succeeding progress reports will not be as tardy as this one. Specifically, Quarterly Report No. 2 is to be submitted to the printer on December 1st, and you should receive it as soon as the succeeding publication technicalities will permit.

Very truly yours,

F. M. Verzuh
Director

V:T

CC: Adm. Office (WADC)
Dr. E. P. Little
Prof. P. M. Morse (MIT)

Abstract

This report is primarily concerned with the solution of boundary-value problems by means of automatic computing equipment (both analogue and digital). Specifically, in addition to the familiar desk calculator, the following digital computers were used in this study: the type 602A Electromechanical Calculator, the type 604 Electronic Calculator, the Card Programmed Calculator, and the M.I.T. Whirlwind Computer. The analogue studies were obtained by use of the M.I.T. Rockefeller Differential Analyzer.

This study is primarily concerned with the solution of ordinary differential equations in which certain boundary conditions are specified at two or more values of the independent variable. Such problems are generally called boundary-value problems. It is clearly evident that the solution of such problems is inherently more difficult than the solution of initial-value problems in which all conditions are specified at one point. The particular problems studied are further complicated by the fact that their solutions are required over an infinite range which contains regions of non-analyticity.

A computational philosophy is presented which emphasizes that a machine must be evaluated on a firm engineering and economic basis--a basis which must include the entire computational procedure. An evaluation is given of the relative advantages and limitations of the five computers used in this study. A fair evaluation must include the time for: problem preparation, numerical analysis, programming, coding, machine setup, machine solution, checking, and so forth. The accuracy and cost of a particular solution must also be included.

This report also illustrates the manner in which the techniques for solving simultaneous linear algebraic equations are applied to the solution of the boundary value problem. A detailed description of the entire computational procedure characteristic to each computer is given in an associated Appendix.

F. M. Verzuh
November 25, 1952