Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, OCTOBER 19, 1953

To: Jay W. Forrester

From: Scientific and Engineering Computation Group

1. MATHEMATICS, CODING AND APPLICATIONS

1.1 Introduction

During the period covered by this report 207 coded programs were run on the time allocated to the Scientific and Engineering Computation (S&EC) Group. These programs represent part of the work that has been carried on in 20 of the problems that have been accepted by the S&EC Group. Progress on each of these problems is given below in terms of programming hours, minutes of computer time, and progress reports as submitted by the programmers in question.

The following five problems have been accepted by the S&EC Group for solution on WWI:

Problem No. 148	Elliptic Boundary Value Problem (Lifting Line Theory) H. Glantz, Mathematics Department
Problem No. 149	Digital Methods of Detecting Signal From Noise G. Dinneen, Lincoln Laboratory
Problem No. 151	Programming and Analysis of General Game of NIM D. Sternlight, Mathematics Department
Problem No. 152	Diffusion In An Oxide Coated Cathode B. Frost, Digital Computer Laboratory
Problem No. 153	Gust Response; Simultaneous Linear Integro-Diff. Equation K. Foss, Aeroelastic and Structures Laboratory

Detailed reports describing these problems will be presented in future biweekly reports.

Although none of the programmers associated with the S&EC Group is developing routines expressly for the library of subroutines, some of the programs that have been developed for specific applications have proved to be of general utility. Such programs are transcribed to a subroutine form, tested, and then written up for

the library. At present 13 such routines are available with two more under test. Progress in this work is described under Problem No. 141. This library does not include the automatic (output and PA) routines in the CS.

1.2 Programs and Computer Operation

100. Comprehensive System of Service Routines: Gombelic, 1.5 hours; Denman, 59 hours; Demurjian, 8.5 hours; Frankovich, 8.5 hours; Kopley, 6 hours; Porter, 4 hours; Helwig, 17 hours; WWI, 224 minutes

Tests were made for using the character generator in CS scope post mortems. Results revealed that this method is about six and a half times as fast as the previously used point-by-point method. All 2016 registers of storage were recorded as octal constants in 11.5 seconds. However, it has not yet been decided whether the numbers are sufficiently legible. The size of the numbers was about twice that used by Group 61. This was accomplished by adjusting the gain. Whether this can be done without affecting point-by-point plotting is being investigated.

Kopley

The new conversion routine for transforming (24,6) floating-point numbers into normalized decimal form ($\pm$ .12345678 | $\pm$ 12), written for the new drum Post Mortem, was completed, and the first tests indicate that it operated correctly. It is written in closed subroutine form, in WWI code, and is entered with magnetic-tape unit #3 running and with ca x in the AC, where x is the address of the first half of the number in storage to be converted. The routine now occupies about 200 registers (including its own programmed arithmetic) and requires about 116 milliseconds to record the 15 Flexowriter characters per number on tape for delayed printing. No round-off facility has been included.

This routine is to be rewritten as a sub-routine for users of CS to print out the contents of the MRA.

Denman

It was discovered that some of the numbers printed out by the automatic CS output routines were in error in the fifth decimal place. This error was due to a special-add overflow that was not picked up. The error has been corrected.

Porter

101. Optical Properties of Thin Metal Films: Denman, 2 hours; Loeb, 3 hours; Richmond, 4 hours; WWI, 7 minutes

Although the program worked with one set of parameters, it failed to work with another set of parameters of the same order of magnitude. There was a divide and an its alarm. We are now trying to find the source of the trouble.

Loeb

106. MIT Seismic Project: Briscoe, 40 hours; Simpson, 20 hours; Walsh, 20 hours; WWI, 142 minutes

Correlations have been computed for intervals of seismogram over which linear operators have been computed. These can be interpreted so as to optimize the operator structure before least squares fitting is effected. A program to set up normal equations for general operator structure has been written and is being tested.

Another study underway is the comparison of averaged operators and averaged error curves. New programs include a subroutine to plot numbers as well as print them out on the delayed printer, and an averaging program to sample the changing mean on seismogram readings.

Further tests have been made on a power-density-spectrum program.

Robinson

108. An Interpretive Program: Hazel, 1 hour; Zierler, 60 hours; WWI, 35 minutes

Enough of the program now operates satisfactorily so that it can be used for the solution of non-trivial problems. The following are the only features not yet operating correctly: automatic computation of special functions and the assignment of variables to the drum. It is expected that the entire program will be in operation and that a report describing the program in detail will appear within the next few weeks.

Zierler

109. Fighter Gunsight Calibration, 8th Order D.E.: Hellman, 1 hour; Frankovich, .5 hours; WWI, 13 minutes

Three runs were made during this period. An error was encountered in the CS output routine. This made it necessary to change the program print routine to incorporate Tape No. 2299-6. A test run incorporating this print subroutine was successful.

The initial conditions for a three-dimensional pursuit-course problem are being determined. Coding for this problem should be completed during the next biweekly period.

Hellman

116. Torpedo Impulse Response; Convolution: Hamilton, 30 hours; WWI, 11 minutes

All convolutions and computations have been completed for the report being prepared on the problem of finding impulse responses for various input-output pairs.

An inverse transform and possibly another convolution will be performed on WWI after the report has been completed. After these have been performed our problem will be terminated.

Kramer

119. Spherical Wave Propagation: Ralston, 20 hours; WWI, 102 minutes

One successful run of 37 minutes has carried the computation twice as far as previously. A first glance at the results tends to indicate that a shock is not going to form as expected.

The next run will continue the computation from where it stopped and may indicate conclusively whether or not a shock will form. If so, this will complete this phase of the problem.

Ralston

126. Data Reduction: Ross, 60 hours; Hamilton, 10 hours; Frankovich, 2 hours; WWI, 193 minutes

Several sections of the Mistake Diagnosis Routine are now known to be operative. Considerable time was lost during this period due to the difficulty of locating a tape-preparation mistake. Further time was lost due to the computer dropping a sign digit repeatedly. For this no explanation has been found. Several necessary modifications to the program disclosed by a successful test run have not been tested because of tape errors.

Ross

132. Subroutine Study for the Numerically Controlled Milling Machine: Runyon, 35 hours; Frankovich, 4 hours; WWI, 101 minutes

Writing of the program for preparing NCMM tape for a super-sonic nozzle was completed. Another program which furnishes tool-center coordinates of one cross section of the nozzle was run successfully using the nozzle dimensions. Two subroutines, one of which is used in the nozzle program, are in the process of being tested.

Runyon

136. Matrix Equations: Arden, 20 hours; Helwig, 16 hours; WWI, 21 minutes

The program described in the biweekly report of June 1, 1953 has been transcribed into subroutine form. After further testing, the transcription will be placed in the subroutine library of WWI.

Arden

An n step procedure for solving systems of linear equations has been derived which includes the conjugate gradient method and the method described by Craig (M-2229) as special cases. The generalization suggests other n step methods but reasons for using these methods in place of the conjugate gradient method have not been found. Work on further generalization is continuing.

Helwig

137. Investigation of Atmospheric Turbulence; Autocorrelation, Crosscorrelation and Fourier Transforms: Summers, 20 hours; Block 8 hours; Kopley, .5 hours; WWI, 116 minutes

Successful determination of the Run II Autocorrelation functions for 100-200 values of the original data time spacing (Δt) was accomplished using the basic crosscorrelation program (T-2751 or 3068), but starting the second data-tape read-in on the fifth block. For Run I, however, the 100-200Δt points were not consistent with the 0-100Δt computation. This may have been due to starting with the wrong block; the proper starting points will be clearly marked on the tapes and performance requests resubmitted.

The Fourier transform program (T-2235m18) was used to take the transform of a unit step and results seemed satisfactory. This program was then modified to eliminate the use of Simpson's rule, but, when used on the flight data, "negative" power was still obtained. The program will have to be examined more closely.

Completion of the problem now depends almost entirely on suitable modification of the Fourier transform program so as to eliminate that "negative" power.

Summers

138. Spheroidal Wave Functions: Combelic, 4.5 hours; Little, 30 hours; Corbató, 50 hours; WWI, 84 minutes

The "Ratio Converters and Accumulators" program has been tested. A run of this routine with the previously tested "Layout" program utilizing the magnetic drum has now been made and works satisfactorily.

A (15,0) decimal integer delayed print routine was required for testing. Such a routine was assembled, tested and submitted to the library of subroutines for general use.

Corbató

The routine for calculation of the ratios of the coefficients is being modified to give greater accuracy and to take less time. It is about ready for use. In the course of testing an error was found in the auxiliary buffer subroutine, File 2767; this mistake has been corrected.

Little

140. Summer Session System: Combelic, 48 hours; Helwig, 8 hours; Frankovich, 20.5 hours; Hoy, 8 hours; Siegel, 46 hours; WWI, 335 minutes

The changes in the input-output instructions of the Summer Session Computer, which were described in the previous biweekly report, have been completed and tested. These changes are now in effect.

A test program, which tests every instruction of the computer and indicates which, if any, of them is not operating properly has been written. Some minor errors, located by this program and by other means, have been corrected. Effort is being directed toward locating and eliminating all such remaining errors.

The several punched tapes which comprise the computer have been combined into one tape. This permits reading the tape into WWI without special instructions to the operators. A program which will record the subroutines on magnetic tape unit 1 and will permit their automatic reading from the magnetic tape to the drum is being written. This program will obviate entirely the need for reading in a long punched tape each time the computer is to be used.

Thought is being given to the development of a subroutine library for the Summer Session Computer. Since there is no provision for the use of relative addresses, means for incorporating library subroutines into a program without conflict of floating addresses are being studied. It has been decided to reserve floating addresses numbered 900 or greater for the use of library subroutines.

A summer session subroutine for finding the square root of a number is being written and will undergo tests during the next biweekly period. Another subroutine written by C.W.Adams, for alphanumerical character display on the oscilloscope has been tested and operates properly. This routine will be available for use by students in Course 6.535.

A program, also the work of Professor Adams, for the solution by several methods of the differential equation $y' = 1 - y^2$ was run on the computer with good results.

A study of the interpretive subroutines used by the computer with the aim of producing accurate annotated copies of their contents has been initiated. No

such copies exist at present. They will be an invaluable aid in amending or modifying the operation of the computer in the future if changes should appear advisable.

Siegel

141. S&EC Subroutine Study: Arden, 4 hours; Vanderburgh, 2 hours; WWI, 7 minutes

A new subroutine, consisting of a 23-register addition to subroutine tape 2756m5 is being tested. This addition will enable the user to arrange the output of 2756m5 in certain simple formats.

Arden

A new routine has been added to the subroutine library bringing the total to 13. The new routine will calculate the eigenvalue with the largest absolute magnitude of a real matrix all of whose eigenvalues must be real. This routine was developed under Problem No. 146.

A subroutine for solving a system of linear algebraic equations (the number of equations is limited physically by the available magnetic drum space and mathematically by the accumulated roundoff errors) is being tested by D. Arden (Problem No. 136). A subroutine for the delayed (i.e., via magnetic tape) print out of (15,0) decimal integers is being tested by F. Corbató (Problem No. 138).

Vanderburgh

142. A Study of Shock Waves; Sydney, 60 hours; Bart, 60 hours; WWI, 477 minutes

In the past two weeks the program for the two-dimensional case has been under continued testing.

The program was run in its entirety for the first time on October 18, 1953, and appeared to be functioning satisfactorily. The results of the run are being checked and if they are correct, the program will be ready for further production runs.

Sydney

143. Vibrational Frequency Spectrum of a Copper Crystal; Third Order Polynomial: Jacobsen, 12 hours; WWI, 17 minutes

The complete program in interpretive (24,6) is nearly finished and will be tested with a coarse mesh of 95 points. However, I believe a finer mesh of 25,495 points will be required ultimately. This being the case, I shall have to re-program the routine in PA (15,15) in order to save computer machine time. The object of the interpretive (24,6) routine above was to establish a standard of accuracy and to learn the nature of my problem in terms of Whirlwind language.

Jacobsen

144. Self-consistent Molecular Orbitals: Arden, 7.5 hours; Meckler, 15 hours; WWI, 56 minutes

The program described in the biweekly report of September 20, 1953 has been written. Several technical errors have been discovered and corrected.

Meckler

146. Largest Eigenvalue of Real, Symmetric Matrix: Siegel, 1 hour; Temkin, 2 hours; WWI, 14 minutes

The problem has now been completed and the subroutine for finding the largest eigenvalue of a real matrix (all of whose eigenvalues are real) entered into the library of subroutines as #3168m12. The program was checked against a known problem taken from Milne (Numerical Calculus) and was correct to as many digits as taken there. Another problem was checked against Meckler's program (Problem #134, tape 2613p2m3) and the results checked to six significant figures, and differed by one in the seventh place.

Temkin

147. Energy Bands in Crystals: Arden, 14 hours; Howarth, 20 hours; WWI, 55 minutes

A program for the solution of the differential equation and the calculation of the expressions v_λ (E,r) described in the biweekly report of October 5, 1953, has been successfully completed. A program for the calculation of the $F(E,E_0,r)$ has also been written and is being tested.

Arden

1.3 Operating Statistics

Computer Time

The following indicates the distribution of WWI time allocated to the S&EC Group.

Programs	33 hours, 48 minutes
Conversion	11 hours, 44 minutes
Magnetic-drum Test	05 minutes
Scope Calibration	62 minutes
Total Time Used	46 hours, 39 minutes
Total Time Assigned	55 hours, 52 minutes
Usable time, percentage	83.56%
Number of Programs	207

1.4 Summary of Tape Room Bulletin Board Memoranda (I. Hazel)

(These memos are intended to inform programmers of changes in coding procedure, WWI facilities, etc.)

Programmed Arithmetic (CS)

An error which is not easily correctable has been discovered in the Programmed Arithmetic for the instruction ics b. Programmers using the buffer or the Auxiliary Buffer Subroutine, #2767, should refrain, until further notice, from using the ics instruction on these buffer registers. Suggested alternatives for ics b are:

1. ica (RC + .0)
   isu b

2. ica b
   imr (RC -1.)

i dv Sub-Block of the PA

The i dv sub-block of the PA will be punched out on the 556 tape every time the PA is used whether or not an i dv occurs in the program.

2. COMPUTER ENGINEERING

2.1 WWI System Operation

2.11 Core Memory (N. L. Daggett)

On October 6, the Core Memory ended a six-day stretch without any parity alarms. Since that time there have been several failures in Bank B. Bank A, the new core bank, has still given no failures since the 6th. It appears that the higher delta noise encountered with the old (Bank B) cores makes this bank more susceptible to power transients.

(L. L. Holmes, A.J.Roberts)

We have continued to remove or reroute the power wiring and video cabling in the EX1 - EX8 area. The work was completed on October 10. The racks and wire-ways in this region will be dismantled and removed during the forthcoming biweekly period. This will allow us to locate Core Memory in that section of the room.

2.12 Auxiliary Magnetic-Drum System (K.E.McVicar)

The problem of sluggish relay operation in the group-selection system has been attacked via two routes. The first (and so far not very successful) alternative was to attempt to increase the relay operate speed. The second approach has been to increase the relay setup time counted by the In-Out Delay Counter.

There is reason to suspect that the auxiliary drum is occasionally making an error in a single digit and a single register. The error is permanent rather than transient, i.e., the drum surface has been altered. The digit and register in error seem to vary and are not confined to any particular group.

Tests on the auxiliary drum with an interlace of 4 have been run, and marginal checking of the drum circuits indicates that satisfactory operation can be expected. Permanent change of the interlace will await elimination of the errors mentioned above to avoid confusion which might result from piling the troubles one upon the other.

Work on the logic for a drum parity check is in progress. In the meantime we are starting construction of the elements in the drum required for a parity system.

2.2 Terminal Equipment

2.21 Ferranti PETR (F.E.Irish)

A clutch-brake driver for the Ferranti PETR has been constructed. Using this circuit along with a test-equipment setup, the new PETR has been operated in what is essentially a line-by-line mode.

The maximum speed of the paper tape when used in this reader is 25 inches of tape or 250 Flexowriter characters per second. If the brake is applied while the unit is operating at this speed, the tape will stop its motion in from 0.5 to 1.0 milliseconds. Starting takes from 0.75 to 1.25 milliseconds.

A design for the information-channel amplifiers to be used in this reader is being developed. Roughly speaking, each channel amplifier will consist of a phototube, followed by a single triode amplifier stage and a cathode-follower output.

2.22 Magnetic Tape (E.P.Farnsworth)

Minnesota Mining Co. has supplied us with several reels of high-output green tape on the Scotch acetate base for trial. We have installed one of these reels on unit 3B to check for the twisting action which developed in the first production batch. This tape was broken, apparently through mishandling, less than 12 hours after installation, reemphasizing the importance of the mylar base. 3M is still trying to get 1.5-mil mylar in 1200-foot lengths from Dupont.

During this period, three Raytheon read/record heads become marginal due to mechanical wear, and one failed due to insulation breakdown. Replacement of these heads necessitated rerecording of the "permanently" recorded data on units 0 and 1, much to the consternation of individuals who had assumed greater permanence in magnetic tape than is attributed to punched paper tape, in spite of the possibilities of tape damage due to mishandling, accidental erasure (except on unit 0 which is locked in "read"), head failures, etc.

4. ADMINISTRATION AND PERSONNEL

Terminated Staff (J. C. Proctor)

Roy E. Hegler

New Non-Staff (R. A. Osborne)

Elinor Albanese is a new messenger at the Barta Building.

Pauline Cochary is Mr. Morley's new secretary.

Robert Johnston has joined the Whittemore Building janitor crew.

Eugenia Patterson is a new senior clerk in the Publications Office.

Carol Small has returned to join the Drafting Department.

Terminated Non-Staff

Lillian Durso

Eleanore Galant

Sheila Heffernan

Nancy Heselton

Charlebert Ingram

Edmund Landers