UNIVAC Acceptance Tests.—On February 4–5, 1952, the second UNIVAC, constructed by the Eckert-Mauchly Division of Remington Rand under NBS contract for the Office of the Air Comptroller, USAF, passed a magnetic tape reading and writing test which was the final test for its acceptance. The machine is now being moved from the factory in Philadelphia to the Pentagon Building in Washington, D. C., where its primary activity will be computing logistic programs.

In this test UNIVAC read over 142 million decimal digits from magnetic tapes and wrote over 85 million on tapes in eight hours net running time and two hours down time. It ran without error or stoppage through 23 out of 32 fifteen-minute test units. In the other 9 test units automatic checking circuits stopped the machine for 15 tape reading errors, for two malfunctions of tape driving mechanisms, for two tape defects, and for one tube failure in the computer. No errors escaped the automatic checking circuits.

The same general test of computational ability that was given the first UNIVAC was also given to this machine. (See *MTAC*, v. 5, p. 176–7.) During the 19 twenty-minute test units, the only malfunctions were three tape reading errors which were detected by automatic checking circuits.

The test of the Uniprinter required it to read from magnetic tape and to type 144,000 characters among which occurred every typewriter symbol. This took four hours and fifty-four minutes running time plus nineteen minutes down time. Checking circuits stopped the printer six times, apparently because it picked up spurious pulses in the spaces between blocks of data on the tape. No errors were found in the copy.

The Unityper test required 54,000 characters of instruction codes to be typed onto magnetic tapes and these to be readable by UNIVAC and by Uniprinter. Net typing time was 3½ hours. UNIVAC read all the tapes correctly, but Unityper omitted characters at three points because tape slippage on Unityper had caused them to be recorded too closely together.

In the Bureau of the Census's year of experience with the first UNIVAC the computer has been remarkably reliable except for rather frequent tape reading error; therefore the tape reading and writing test for the second UNIVAC was revised to require nearly five times as much reading. For this reason the similarity in performance of the first and second UNIVACS in their tests really indicate noteworthy improvement in this respect.

OTHER AIDS TO COMPUTATION

Bibliography Z–XIX

13. Anon., "Aircraft and flight-control-system analog," *Instruments*, v. 23, 1950, p. 568, 570.

A description with three pictures of the M. I. T. Flight Simulator constructed under the supervision of A. C. Hall. This device consists of a continuous computer and a three gimbal flight table positioned by hydraulic servos.

F. J. M.

14. Anon., "Analog computer," *Instruments*, v. 24, 1951, p. 772, one photograph.

This article describes a differential analyzer suitable for solving systems of differential equations with constant coefficients constructed for M. I. T. by a Boston firm. The device is electrical, set up by means of patch cords, and can handle six equations in six unknowns. It "is not a commercial product."

F. J. M.

15. Anon., "Knows all angles," *Instruments*, v. 24, 1951, p. 1178, one photograph.

A drawing board instrument is illustrated and described which "gives true horizontal directions from oblique aerial photographs." The device has three parts and is to be used with a specially designed slide rule calculator which gives certain required adjustments.

F. J. M.

16. Anon., "USAF's new jet instrument trainer," *Instruments*, v. 23, 1950, p. 678, 680.

Illustrated article on blind flying trainer (C 11 Link) containing a fixed continuous computer for the aerodynamic equations of flight.

17. M. J. Boho, "Application of computing mechanisms to industrial instruments," *Instruments*, v. 23, 1950, p. 614–616.

The computing mechanisms are adding and multiplying linkages. By means of these one may construct devices to present directly a quantity computed from a number of measured quantities.

F. J. M.

18. B. Chance, F. C. Williams, C. C. Yang, J. Busser, & J. Higgins, "A quarter-square multiplier using a segmented parabolic characteristic," *Rev. Sci. Instruments*, v. 22, 1951, p. 683–688.

The multiplier described was developed for a fast analog computer. The parabolic characteristic is obtained by using 15 suitably biased diodes. The input to the squaring device must be positive. The squares of the sum and difference are obtained from the same squaring circuit on a time sharing principle, the amplitude of the square wave output is then proportional to the difference of these squares and is the required product. The parabolic characteristic covers a range of 0 to 25 volts within .4 percent, the output square wave has a frequency of 50 kilocycles per second and the overall accuracy was better than 1 percent.

F. J. M.

19. T. J. Connolly, S. P. Frankel, & B. H. Sage, "Predicting phase behaviour with digital computers," *Elect. Eng.*, v. 70, 1951, p. 47.

The authors discuss briefly the use of the I.B.M. 604 in certain thermodynamical calculations and refer to a more extensive monograph on this procedure by them, published by American Documentation Institute, Washington, D. C.

F. J. M.

20. J. T. Cortelyou, "Calculation of orifice meter charts by the square root planimeter method," *Instruments*, v. 23, 1950, p. 1081.

The planimeter mentioned but not completely described seems to be an ordinary planimeter suitable for use on the chart output of a recording device and the "square root" appellation refers to certain approximations made in using it.

F. J. M.

21. M. J. Everitt, "A vernier method of using a slide rule," *Jn. Sci. Instruments*, v. 27, 1950, p. 316–317.

22. H. H. Goode, "Simulation—its place in system design," I.R.E., *Proc.*, v. 39, 1951, p. 1501–1506.

The author defines the simulation of a system as the "cut and try examination of its mathematical representation by means of a large analog or digital computer." The design of a system is presented as progressing through a series of steps beginning with an analysis of the expected inputs and "a first order block diagram." The author advocates that the early stages proceed by the use of linearized analysis but as the system takes on definite form he advocates that simulation in the above sense be used before large scale experimentation with actual systems. The latter is very expensive and should be limited as much as possible by "simulation." For simulation purposes the author discusses among others the following topics: (1) Choice of Computer, (2) Programming, (3) Choice of Cases to be Treated, (4) Coding, (5) Machine Set-up, (6) Running, and (7) Data Reduction. In each case he presents a brief summary of experience and practice in the field. For instance in the choice of the computer, he lists types of systems for which automatic digital computers are most suitable and those for which continuous computers are better. However, the joint use of the two types of equipment is not emphasized. This paper is a valuable summary of practice and experience in the field of simulation of systems.

F. J. M.

23. R. A. Harrington, "Generation of functions by windup mechanisms," *Rev. Sci. Instruments*, v. 22, 1951, p. 701–702.

This instrument is based on the use of a suitably shaped cam on which a tape is partly wound. The tape also passes over pulleys and carries a pen. The displacement of the pen is then a prescribed function of the angle of the rotation of the cam. A method is described of cutting a cam for a given function and the limitations on the function are given.

F. J. M.

24. J. C. Jaeger, "A Schmidt mechanism for the approximate solution of the equation of linear flow in a medium whose thermal properties depend on the temperature," *Jn. Sci. Instruments*, v. 27, 1950, p. 226–227.

A drawing board instrument is described for the solution of the equation

$$\frac{\partial}{\partial x}\left(K\frac{\partial v}{\partial x}\right) = \rho c\frac{\partial v}{\partial t} \tag{1}$$

in which K, ρ, and c are prescribed functions of v. Following van Dusen, the substitution $\theta = K_0^{-1}\int_0^v K\,dv$, $K_0 = K(0)$ is made, so that (1) becomes

(2) $\dfrac{\partial^2\theta}{\partial x^2} = \kappa(\theta)^{-1}\dfrac{\partial\theta}{\partial t}$ where $\kappa(\theta) = K/\rho c$. As in the derivation of the Schmidt method for the heat equation with constant properties, it is seen that if (2) is replaced by its usual finite difference approximation with $(\Delta x)^2 = 2(\Delta t)\kappa(\theta)$ then $\theta(x, t + \Delta t) = \frac{1}{2}[\theta(x - \Delta x, t) + \theta(x + \Delta x, t)]$.

In contrast with the customary Schmidt method for constant thermal properties, the required Δx depends here on $\theta(x, t)$. The instrument described produces the required Δx automatically so that as two points of the instrument are caused to trace the curve of $\theta(x, t)$ for a given t, a third point will draw the curve of $\theta(x, t + \Delta t)$. The instrument utilizes a simple pantograph linkage. For each function $\kappa(\theta)$ and choice of Δt, it is necessary to cut a plate cam representing $(2(\Delta t)\kappa(\theta))^{\frac{1}{2}}$. The various boundary conditions are treated as in the usual Schmidt process.

A modification of the instrument is described for the solution of the problem in which a term $A(v)$ is added to the left hand side of (1), representing heat generation in the heat conduction problem. This requires the use of a second plate cam.

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25. H. JEFFERSON & L. M. ERICSSON, "Mu-beta effect calculator," I.R.E., *Proc.*, v. 39, 1951, p. 1571.

An additional method of using the Felker calculator. [I.R.E., *Proc.*, v. 37, 1949, p. 1204–1206; *MTAC*, v. 4, 1950, p. 175.]

26. W. J. KENNEDY, "Chart reading by the Emco McGaughy integrator method," *Instruments*, v. 23, 1950, p. 1082–1083.

This article describes a mechanical computer involving square root cams and a disk integrator which utilizes instrument charts as inputs.

F. J. M.

27. E. LAKATOS, "Checking analogue computer solutions," I.R.E., *Proc.*, v. 39, 1951, p. 1571.

This letter indicates a method of checking an analogue computer against errors in scale factors and machine set up. For differential equations the machine values of the variables and their derivatives are substituted in the equations.

F. J. M.

28. F. J. LLEWELLYN, "A mechanical electrical unit for calculating structure amplitudes," *Jn. Sci. Instruments*, v. 28, 1951, p. 229–230.

This is a device to aid in the evaluation of multiple Fourier series. Multiplication of sin kx by sin ly is obtained by potentiometers. The resolver action is obtained by a cycloidal arrangement of gears. One such unit is used to successively calculate the various terms.

F. J. M.

29. D. L. MACADAM, "Method of colorimetric integration using punched-card accounting machines," Optical Soc. Amer., *Jn.*, v. 40, 1950, p. 138–140.

30. J. H. ROBERTSON, "A simple machine capable of Fourier synthesis calculation," *Jn. Sci. Instruments*, v. 27, 1950, p. 276–278.

This machine is a Fourier synthesizer with a novel method of addition for the terms. The terms cause mirrors to rotate and, consequently, a beam of light successively reflected by all of them is displaced an amount approximately proportional to the sum of the rotations.

F. J. M.

31. M. L. UNGAR, "Probability paper," Permanent Records of Research and Development, Ministry of Supply, Shell Mex House, Strand, London WC 2, England (Sept. 1950).

This monograph describes with samples three types of probability graph paper used in the British Ordnance Factories. Type (a) is based on the normal distribution function and can be used to test whether a distribution is normal and if it is, the mean and standard deviation. Type (b) is used for skew frequency distributions and Type (c) for a Poisson distribution.

F. J. M.

32. V. VAND, "A mechanical x-ray structure-factor calculating machine," *Jn. Sci. Instruments*, v. 27, 1950, p. 257–261.

The machine described is a mechanical device for summing trigonometric series of the type developed by Kelvin. A method is described for varying the basic frequencies along a gradient in order to obtain the best fit to a given empirical curve. A new machine in which the summation process is by moments rather than by the Kelvin pulley method is being developed.

F. J. M.

33. J. F. WATERS, "Instrument for measuring the slope of graphs," *Jn. Sci. Instruments*, v. 28, 1951, p. 116.

34. E. H. WINKLER, "Principle and design of a new type Stieltjes integrator," *Rev. Sci. Instruments*, v. 22, 1951, p. 406–410.

The objective of this device is to evaluate

$$\int_{x_0}^{x_1} F(x)\,dH(x).$$

$F(x)$ and $H(x)$ are given as curves and a mechanical device plots the curve, given parametrically by $v = F(x)$, $u = H(x)$. The area under this curve corresponding to the given integral is then obtained by a planimeter. An electric follower is described which traces a curve drawn with conducting ink. The tracer is to remain on one side of the curve.

F. J. M.

NOTES

132. FURTHER STATISTICS ON THE DIGITS OF e.—An account of the calculation of the first 2500 digits of e on the ENIAC appears in *MTAC*,