COMING EVENTS

Industrial Analysis and Control Council

Date: Friday, 13 August 1954 – NOTE CHANGE from date announced in June Newsletter!

Time: 1330

Place: University of California at Los Angeles; Haynes Hall, Room 146. For further information call E. C. DeLand at the University, Extension 751.

Subject: This will be a meeting of the Steering Committee and others interested in the program to determine details for the next regular meeting of the IACC. At this latter meeting, tentatively planned for Monday, 13 September, there will be a panel composed of proponents of digital computation, analog computation, and industrial process control instruments to discuss the application of these components for more complete automation.

Midwestern Simulation Council

Date: Monday, 16 August 1954

Time: 1330

Place: Armour Research Foundation of Illinois Institute of Technology Commons Building, 3200 South Wabash Avenue, Chicago, Illinois

Subject: Charles Morrill (Goodyear Aircraft), Roger Gaskill (Willow Run Research Center), and Bill Riordan (Advisory Board on Simulation) will lead a discussion of methods of "Checking Simulator Solutions".

Clearance: Confidential Security Clearance will probably be required, so if you haven't already done so, start your requests immediately!
WESCON (Western Electronic Show and Convention)

Date: 25-27 August 1954

Place: Exhibits: Pan-Pacific Auditorium, Los Angeles, California
Technical Sessions: Ambassador Hotel, Los Angeles
Cocktail party, "Sun Club" of the Ambassador, 5:30 to 7:30 PM, Wednesday 25 August. Tickets $5.00 apiece.

Subject: More than 100 papers on many subjects, including Computers and Information Theory

First International Instrument Congress and Exhibition

Date: 13-24 September 1954

Place: Commercial Museum and Convention Hall, Philadelphia

Western Simulation Council

Date: Thursday, 23 September 1954

Time: 1245

Place: Lobby of the Engineering Building, Plant A-1, Lockheed Aircraft Corporation, Burbank, California. Parking will be provided at Lot No. 3, on the approach to Lockheed Air Terminal from Hollywood Way.

Subject: This meeting will begin with a tour of the Lockheed computing facilities and will be followed by a meeting at the Lockheed Employees Recreation Club. The facilities include a network or direct analog computer, a digital differential analyzer, an electronic differential analyzer installation, and 2 IBM 701 digital computers.

At the meeting Don Greenwood (Lockheed) will give a talk on the network type analog computer and William Schroeder (Lockheed) will speak on the digital differential analyzer. Both talks will be designed to stimulate discussion from the floor, so if you have any ideas on either of these or related subjects, come on out!

Clearance: None will be required, but we do request that you fill in the coupon at the end of this Newsletter if there is a chance that you might attend. Mail the coupon to B. T. Greenwood, Group Engineer, Mathematical Analysis Department, Lockheed Aircraft Corporation, Burbank. This way, you'll be sure of a place to sit!

Western Simulation Council

Date: Thursday, 18 November 1954 (Second Anniversary Meeting)

Time: 1300

Place: J. B. Rea Company, 1723 Cloverfield Blvd., Santa Monica, California
First International Automation Exposition

Date: 29 November - 3 December 1954

Place: 242nd Coast Artillery Armory, New York, N.Y. For further details address 845 Ridge Avenue, Pittsburgh 1, Pennsylvania.

Eastern Joint Computer Conference

Date: 8-10 December 1954

Place: Bellevue-Stratford Hotel, Philadelphia, Pennsylvania

Subject: "Design and Application of Small Digital Computers". There will also be an exhibit by more than 60 companies in the computer field and conducted tours to computer installations and manufacturers' plants. For registration information write Post Office Box 7825, Philadelphia 1, Pennsylvania.

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BIT  S (The smallest units of information)

We (and I don't mean the editorial "we" but Suzie and me) liked an expression by Allyn Janes of Gevalt-Knoop Company, who said that our Newsletter "lacks the atmosphere of having been engraved in stone for the ages." Therefore we will attempt to give you a quick rundown sans stone-carrying of what is in the rest of this Newsletter so that you can't say we didn't warn you!

First and most important to us is a brief story of the Western Simulation Council meeting at Aerojet-General on July 22nd. One reason it's brief is that your Editor's train of thought was thrown off the track by too many partial differential equations and LePlacean transforms. The other is that it has been and will continue to be our policy (unless we get screams from you guys) not to be middleman on technical details but to refer our readers directly to the source.

Then we have a few words to say about an AIChE meeting, at which our friend, J. G. Ziegler of Taylor Instrument Companies, told how life could be made easier - if not beautiful - for control man by sometimes comparatively simple system changes in the design stage.

Finally we will try in our section entitled "Information (without) Theory" to give you various pieces of miscellaneous information which we think might be of interest, but which we certainly cannot always support by any rational theory.

- 3 -

176a
PIECES

Western Simulation Council - Meeting at Aerojet-General, 22 July 1954

Norman Irvine in behalf of our host, the Aerojet-General Corporation of Azusa, Calif., introduced Mr. R. W. Powell, Chief Engineer of the Electronics and Guidance Division, who officially welcomed the 36 representatives of 19 organizations and explained Aerojet's need for and use of simulation.

Mr. Powell told us about a temperance lecture he remembers from his childhood which showed a series of lantern slides. The first depicted a tiny reptile the size of a garter snake labelled "Liquor," with the caption "Isn't it cute?". In the next one the snake was much bigger and the caption was "Look how he grows!" The third showed quite a large serpent and was entitled "Gee, he eats a lot." Then in the final picture the serpent, now the size of an enormous boa constrictor, had man-sized lumps in him which were screaming "Help!"

Mr. Powell says they have been through the first two stages with simulation - thinking it's cute and watching it grow - and they are now letting it "eat a lot" because they have found simulation one of the best ways to determine the dynamic behavior of some of their complicated gadgets. We join Mr. Powell in hoping they will not be brought to the point of yelling "Help!"

After Norm Irvine had given a very interesting introduction to Jesse Denton and his subject, "The Use of Analog Computers for the Solution of Algebraic Problems", and discussed at some length the importance of this work, he was informed by Stan Rogers (Convair, San Diego, Calif.) that Jesse couldn't make the meeting and that therefore he, Stan, would deliver Jesse's paper. Furthermore this paper was not on the solution of algebraic equations, but on the solution of heat transfer problems by lumped constant electrical analogs.

The problem arose in connection with a desire to measure accurately the temperature at points on a ramjet. An obvious way was to weld thermocouples to the ramjet at the points of interest, but of course the thermal capacity of the thermocouple and weld distorted the thermal gradient. To determine the extent of this distortion so that the temperature of the ramjet in the absence of the thermocouples could be calculated, an 8-section electrical network as shown in Figure 1 was constructed.

![Figure 1](image-url)

**Figure 1. Thermodynamic Configuration and Corresponding Electrical Analog**

- 4 -

177
For simplicity the outside of the ramjet was considered to be perfectly insulated. Construction of this network created the problem of measuring the voltage accurately, i.e. without loading, at the junctions of the impedances. One way to do this is shown in Figure 2.

![Figure 2. Capacitor-Input Circuit for Measuring Voltage at Point O](image)

A high-gain amplifier with the same impedance in the feedback loop and the input will act as a summing amplifier, whether those inputs be resistive or capacitive. This worked fine for measuring the potential at the junction as Jess wanted to, but it was a bit tricky so an alternative plan, shown in Figure 3, was tried.

![Figure 3. Resistor-Input Circuit for Measuring Voltage at Point O](image)
The actual ground was replaced by the summing junction of an amplifier. The output voltage is proportional to the voltage at the point in question, the factor of proportionality being determined by the ratio of the two resistances. By choosing the feedback resistor properly, Jess was able to get the desired measurement with the proper scale factor. The results, which show how much the temperature measured by the thermocouple actually lagged behind the temperature some distance away, are shown in Figure 4.

Figure 4. Depression of Wall Temperature by Thermocouple Installation

- $T_g = 3600^\circ F$  $T_o = 100^\circ F$
- Plate Thickness = 1/32''
- Weld Thickness = 1/8''
- Weld Diameter = 21/8''
- $h_o = 67$ BTU/HR FT $^\circ F$
- $k = 130$ BTU/HR FT $^\circ F$/IN

(The jiggles in the lines are courtesy of JHM III, not the Schenley Company)

John McLeod wanted to know if the tests showed that the rocket would burn up at sea level. Stan said he didn't know - that Jess said this was a theoretical problem to give us something to talk about at unclassified meetings.

Bob Olds (U.S. Naval Ordnance Test Station, Inyokern, Calif.) mentioned a "well-known" technique of connecting two amplifiers in such a way as to measure voltages without drawing current. Stan objected that this might introduce some disturbance because when the gain of such a circuit is pushed up to 2, to get 100% unity feedback, it is marginally stable. Bob said that it was stable if it had "something to hold onto" (i.e., if the points of measurement were of low impedance) - that in fact the gain could be pushed to greater than 2 so that current would actually be fed back into the point of measurement. Bob drew the diagram, Figure 5, and explained that if the point of observation was pinned onto

![Diagram](image)
some definite voltage, the system would be stable. Stan pointed out that Jesse's system took only one amplifier where Olds' took two.

Dov Abramis (Convair-Pomona, California) said they had done some work recently in thermodynamics: that whereas the differential analyzer was not usually considered suitable for partial differential equations, the University of Michigan had done some good work along these lines. They at Convair-Pomona had solved some sample heat transfer problems trying to convince their thermo-dynamic group that, drawing on information from NOTS and JPL, they could do some good along these lines. Then they got a problem which is the largest they've had, involving all of their equipment – 250 operational amplifiers, servos, and so forth. They solved this problem – not supposed to be suitable for analog equipment – within two-and-a-half weeks, working on the third shift (from 1 o'clock in the morning till 8), and got excellent results much more quickly than they could have expected to get from their 701. They found that this problem, which involves some physical flow of liquid besides the heat flow, was done much more economically on analog equipment.

McLeod wanted to know if the unexpectedly good results were caused by the phenomenon mentioned recently by Bob Olds speaking on the PGEA panel (June Newsletter) – the apparent ability of some analog computers to transcend human error! Dov replied that in this case it was the computer which made the answers come out right – not an act of God!

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Norm arose to the next occasion by explaining that he was in the same fix as Stan – the man supposed to talk about transmission dead times couldn't make the meeting (do our informal "discussions" scare people?) so Norm would have to take over. Norm explained that he didn't understand transmission lines and therefore would simply take the equations as they were given to him and would show us a couple of things not to do in attempting to solve transmission line equations. He said they first tried to take the LaPlace transforms which gave equations of hyperbolic functions. Because of the extreme difficulty of instrumenting hyperbolic functions, they generated them by series expansion. But then they found that if they did not carry the expansion to at least eleven terms, each of which required 3 amplifiers, an apparent negative inductance would result. (Now design for a generator, or possibly that a.c. battery?)

On the other hand, 33 amplifiers for each of 2 equations would mean that they were tying up 66 amplifiers to solve one transmission line problem, and this was not tolerable either. So this is one system you shouldn't try!

They are currently trying another technique which to date has met with reasonable success. This method involves the development of actual dead time, which they have attempted in two ways. One involved the use of amplifiers, and again they found that this ate up amplifiers like the boa constrictor in the temperance story. In order to introduce the dead times out to the frequencies required, they would have to use so many amplifiers that they would have none left for the rest of the problem. So they found something else not to do.

They are now trying a tape recorder to create dead times. They use one Ampex FM Model 306, at 30 inches per second tape speed, on which the distance between the record and playback heads is such that they got something like 70 milli-seconds' delay. By juggling time scales in their problem, they are able to use this. They also borrowed another tape recorder with a tape speed of 15 inches.
per second, which gives roughly 1/40 milliseconds' delay. They like the magnetic tape system, but Norm says that if such a high frequency response were not required they would prefer the cascading of amplifiers.

Norm regretted having to declassify the presentation, because he said the problem was an interesting one, and this requirement for dead time appears in all sorts of problems other than transmission lines. There seems to be no good solution to it, so maybe it should be the subject of a future Simulation Council meeting. Dr. Otis Updike (now of US Naval Air Missile Test Center, Pt. Mugu, Calif. — on leave from University of Virginia) wanted to know about the use of acoustic delay lines. Any ideas?

Dov Abramis said that they wanted to use a tape recorder for the generation of dead time, and asked if Norm had found that the speed was actually constant enough. Norm replied that they did not have Speed Lock, but that they found the tape speed was sufficiently constant without it. He ran a check on the delays he got, using a Berkeley counter, and found variations of the order of 4 parts in 684, which was tolerable. After they have proven their technique, however, he thinks that Speed Lock or some other method of speed control might be used.

Dov then mentioned the Association for Computing Machinery paper on the generation of dead time by using amplifiers ("Transport Delay Simulation Circuits", Charles H. Single and Gilbert S. Stubbs, Westinghouse Electric Corp., Pittsburgh, Penna.) and Norm mentioned the paper by C. D. Morrill of Goodyear Aircraft which covers a similar technique.

Hartzberg (Navy Electronics Laboratory, San Diego, Calif.) asked if Norm had set up the problem for arbitrary or particular inputs to the transmission line. Norm answered that the inputs were arbitrary.

Stan Rogers wanted to know if Norm was familiar with Warshawsky's modification of the Goodyear technique which developed an extremely simple instrumentation for dead time, mathematically the same as Morrill's.

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After the discussion we visited the Aerojet-General Proving Ground (where they fired a rocket for us), the General Instrumentation Laboratory (where they used a resonant beam to shake a component apart), and the Electronics and Guidance Division, where the Simulator Laboratory is located. There they are currently in production on a large number of computing amplifiers (feeding the serpent!) to expand the facility as fast as they can. They say theirs is typical of computer installations, where you start with a small installation and get a few men sold. From then on you aren't able to keep up with the demand!

McLeod asked why they were building their own. Norm replied that one reason is that with commercial equipment, when something goes wrong you damn near have to go through a development program in order to troubleshoot, whereas they can build it as cheaply as they can buy it, and when they are through they have men who know the intricacies of the circuitry and know what to look for when trouble occurs.

The Simulation Council Newsletter will reserve space for rebuttal by our friends who design, manufacture, and sell commercial equipment!

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- 8 -
Meeting of AIChe - 20 July 1954

We went to hear John Gregg Ziegler, Pacific Coast Engineer of Taylor Instrument Companies, tell the local chapter of the American Institute of Chemical Engineers about the application of automatic controllers (which we like to think of as analog computers) to certain chemical processes. Arnold Ames of C. F. Braun was chairman of this meeting, which being attended by 93 persons, attested to the growing interest in automatic control.

Zieg's humor* and presentation were so good that the meeting would have been worth attending even if he hadn't said anything, but he did. He emphasized with specific illustrations that very often slight changes in the design of a process can change the process from being practically impossible to control into one which can be controlled much more easily and/or better.

Of course, this will surprise no one with a systems engineering point of view, because obviously both the process and the controllers constitute one closed loop system. However, as long as designers of chemical, or any other, process (yes, and missile systems too) continue to design first and then call in a control engineer with the attitude "Now control it!" we will need people like Zieg to keep telling 'em, "It shouldn't oughter be done that way" - and backing up their point with the hard facts of systems engineering experience.

INFORMATION (WITHOUT) THEORY

Some time ago we received a letter from Statistical Instrument Company (90 Church Street, New York 7) which we think many of our readers will find interesting. It reads in part as follows:

"We were happy to learn from reviewing the last issue of the Simulation Council Newsletter, that part of your discussion evolved around the Statistical Instrument Company and the low frequency noise generator, RUG-1-10. It was also noticed that the information available regarding the SICO was inadequate to appreciate the claims presented in the flyer issued on the Model RUG-1-10 low frequency noise generator.

"It is with the intention of clarifying our position and because of our genuine interest in noise problems and statistics as applied to engineering systems that we take this opportunity to contact the Simulation Council and present additional data on the SICO which we offer for open discussion at a forthcoming meeting.

"The SICO is a newly formed organization interested in the Ultra Low Frequency band and the problems introduced by noise to engineering systems. We are attempting to apply the principles to engineering systems and have developed several instruments and are considering development of still others in this field.

"The initial effort on the RUG-1-10 generator was presented to industry as an entry and to furnish data to be used in evaluating industry's reaction to our claims and to use the resulting inquiries as a guide to further development effort.

*Among other things, his "definitions" got a general chuckle, i.e. "Step-change - money found on the stairs", etc."
The replies received were great in number and most gratifying but presented to us the fact that perhaps we had been a bit too optimistic in our Model RUG-1-10, 3 probability distribution noise generator and as a result have discontinued all effort on this model. Industry's great demand has resulted in the development of our Gaussian ULF noise generator on which production is now underway and which resembles the RUG-1-10 instrument physically.

Characteristics of this generator are as follows:

Frequency response to 1000 cps. in 3 steps; 0-10; 0-100; 0-1000 cps. flat to 1 db.
Gaussian probability distribution accurate to 2%
Output metered and continuously variable to 5v. rms maximum.
The meter is essentially a form of amplitude distribution analyzer, which measures the rms value of the noise level to provide the reference output.
Cathode follower low impedance output approximately 1000 ohms, with a mean value for the noise of zero volts to within the drift rate.
Output drift rate 0.1 volt/4 hrs (actual measurement)
Drift rate reduced by including a highly stabilized power supply for accurate output.
Construction similar to RUG-1-10 model, rack mounting 19x9x15.
Although the output has been established at 5v rms, we can increase the output level as desired. In addition, chopper stabilization can be provided to reduce the output drift to any desired value.
Price: $495.00 F.O.B., N.Y. 8 N.Y. (less chopper stabilization)
$635.00 F.O.B., N.Y. 8 N.Y. (including chopper stabilization)

We hope the information contained herein will suffice for the purpose of discussion during your meeting. We also solicit further inquiries and will be happy to furnish any additional information regarding Model G-1-1000, or the Statistical Instrument Co.

We will be happy, if you desire, to furnish on loan one of our model G-1-1000 generators for demonstration at future Simulation Council meetings.

(A good idea – if readers express an interest we will arrange it.)

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We would like to recommend as most interesting an article "Tomorrow's Management" which appeared in Business Week of 15 August 1953, a reprint of which was given to us by Lt.Cdr. Jim Aller, a former (?) digital man (RAYDAC) but now boss of the Guidance Division which operates the Simulation (analog) Lab at NAMTC.

We don't agree with everything in the article, but certainly some of its points are well taken, and its prediction concerning the impact of computers and automation on industry and labor – by 1980 – are well worth careful consideration. Reprints are available at 20¢ each from Reader Service Department, Business Week, 330 West 42nd St., New York 36, N.Y.

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We appreciate a letter from Major Richard C. Lethrop of the Wright-Patterson Air Force Base, Ohio, which reads in part:

"I would like to add a few remarks to Mr. Warshawsky's letter* of a few months back. At that time, you may recall that he discussed a trajectory

*See the Newsletter for last March.
problem in which REAC and OARAC solutions were compared, and (finally) agreed rather well. At that time, we were unable to get good agreement (closer than about 5%) with solutions run on the MAADDIDA in my laboratory. I will be the first to agree that the MAADDIDA has its shortcomings, but in all fairness, it should be pointed out that, since the original attempts, the MAADDIDA was recoded with a more logical integrator arrangement and with an erroneous drag coefficient corrected (these things happen!). The resulting solution agrees with the OARAC and REAC solutions to within about .5% for one variable, and even better for the others. The MAADDIDA is undoubtedly capable of greater accuracy if you are willing to wait long enough for the answers."

How do you like that .5% (point 3 percent!) — and even better?

Thanks, Dick; if we had more letters like yours — and Warshawsky's which prompted it — we would have a much better Newsletter.

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We note that our friend (i.e., a subscriber) Leonard Nalley is no longer with Northrop but is giving his full time to his own business and is now offering — among other things — his "D-2A" fourteen stabilized amplifier desktop electronic analog computer, which is advertised as "Stable — Accurate — Lightweight" at \$5,600.

For additional information write Leonard at 833 West Plum St., Compton, California.

THE PAYOFF

To subscribe to the Simulation Council Newsletter, send a check for \$10.00 to the Simulation Council, Box 731, Camarillo, California. The ten bucks cover the cost of a one-year's subscription.

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We liked the definition of an Expert given by H. R. J. Grosch of General Electric at the Eastern Joint Computer Conference last year. Having been introduced as an Expert by the chairman, he reminded his audience that "X" stands for an "unknown quantity" and that a "spurt" is a "drip, under pressure".

Any "Experts" reading this?

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If there is a chance that you will attend the September meeting of the Simulation Council, please tear off and mail the following:

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Mr. Don Greenwood, Group Engineer
Mathematical Analysis Department
Lockheed Aircraft Corporation
Burbank, California

I expect to attend the September meeting of the Simulation Council on the afternoon of Thursday, 23 September, at Lockheed. There will possibly be a total of ___ people in ___ cars from my organization. We are all U.S. citizens. I understand that no Security Clearance will be required.

Signed:____________________
Affiliation________________

- 11 -
184