THE SIMULATION COUNCIL

Simulation Council Newsletter

John H. McLeod, Jr., Editor
Camarillo, California

Suzette McLeod, Secretary
October 1953

Considering the TYPHOON in Pennsylvania, the CYCLONE in New York, and the WHIRLWIND in Massachusetts, we are lucky to be back in California where the HURRICANE has blown itself out, leaving only a BREEZE at Point Argu.

We are sorry to be late with the October Newsletter, but we didn't blow in home until the second week in November. Because there was no October meeting of the Simulation Council, this Newsletter will be devoted largely to those aspects of simulation discussed and observed by your Secretary and Editor on their trip.

Our first stop of interest was New Orleans, but we found no simulation there. Those people go in strictly for the real thing!

Next we called on my old friend Dick Baker, who is head of Vitro Corporation's Technical Support Group at Eglin Air Force Base, Florida. I was interested in finding out what is being done or planned at Eglin in the line of simulation or electronic computation. We found that there is no analog work being done or contemplated, but the Armament Test Center does expect to obtain an ERA 1103 which will be available for data processing.

We were also interested in the Air Force Proving Ground Command's Climatic Hangar at Eglin, because your editor believes that when simulation is used to evaluate existing equipment (as it is at NAFTC), the ultimate objective should be a combination of Functional and Environmental Simulation. The Functional Simulation should include as many actual components as practical*, and analog or other simulation techniques should be used only to close the feedback loops so that the components can function normally.

In the case of a missile, Environmental Simulation obviously cannot include subjecting the hardware to all environmental conditions simultaneously. We would like to keep the components in the laboratory! However, some conditions can be simulated simultaneously, and possibly in combination with the Functional Simulation.

**"What is practical?" could be the subject of a complete issue, and we would still not get wide agreement. For instance, are three-axis flight tables "practical"?
With this in mind we asked Dick to introduce us to Mr. C. W. Kniffin, Assistant Chief of the Climatic Laboratory. We found to our surprise that the large hangar we had heard about was only one part of the Climatic Laboratory, which includes several additional environmental chambers and other facilities. We understand that this laboratory, which is described in detail in a report prepared by the Air Force Proving Ground Command, is available to other agencies of the Government.

Although much larger (the Climatic Hangar can house a medium jet bomber, with jets running, and subject it to the full range of its operational temperatures) and more expensive (estimated cost to duplicate: fifteen megabucks) than would be required for missile work, our conversation with Mr. Kniffin revealed that much of the experience gained in the development and operation of this facility would be applicable to a smaller installation.

When we saw the Climatic Hangar the large door, comprising one whole end, was open to the hot Florida sun and air. Inside the hanger, snow and ice – quite an anomaly!

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Next stop, the TYPHOON Symposium, the pièce de résistance* of the trip. For the benefit of those who did not receive a program we reprint it herewith so that readers can contact the authors on subjects in which they are interested.

Project TYPHOON

Sponsored by Bureau of Aeronautics and U.S. Naval Air Development Center, Analytical and Computer Department – Johnsville, Pennsylvania


Symposium Committee

W. H. Boghosian, Chairman
H. G. Tremblay
F. O. Mitchell, LT

Classified Sessions – Monday, 12 October 1953

Introduction – Cdr. I. K. Blough, Director
Analytical & Computer Department
U.S. Naval Air Development Center

Welcoming Address – RADI R. S. Hatcher
Assistant Chief for Research & Development
Bureau of Aeronautics

Morning Session – Chairman – CDR Walter H. Keen, Jr., USN

"Naval War College Electronic Maneuver Board"
By CDR H. H. Larsen, Naval War College, Newport, R.I.
"Solution of a Three-dimensional Guidance Problem at the New Cyclone Simulation Laboratory"
By H. Heissinger, A. Zeichner, Reeves Instrument Corporation

*"pièce de résistance"; the girl said no!
"The Role of the Analog Computer in the Development of Anti-Aircraft Missiles"
  By T. Hairson, Raytheon Manufacturing Company
"The Adjoint Computing Method Applied to Guided Missile System Design"
  By R. R. Bennett, R. R. Favreau, I. Pfeffer, Hughes Aircraft Company

Afternoon Session – Chairman: Dr. Weigand

"Symmetric Air War Game Simulator"
  By U.S. Air Force, Air Research & Development Command, Baltimore
"Guided Missile Simulation on the Ordvac"
  By J. C. Lester, Ballistic Research Laboratories, Aberdeen Proving Ground
"Flight Simulation of a Guided Missile"
  By R. V. Bond, North American Aviation, Inc.
"Simulation at NAITC of the Harquardt Ramjet Fuel Control System for Project Rigel"
  By G. W. Smith, Harquardt Aircraft Company and W. F. Uplinger, U. S. Naval
  Air Missile Test Center
"High-Speed Digital Computation in the Guidance Studies of an Automatic Inter-
  ceptor"
  By W. F. Bauer, R. A. Beach, Willow Run Research Center
"A Digital Computer for Missile Guidance"
  By J. E. Deturk, W. F. Bauer, W. G. Brown, Willow Run Research Center
"An Operational Analog of the 20mm Mk 12 100 O Machine Gun"
  By R. J. Schaid, H. W. Schultz, Aerial Measurements Laboratory

Tuesday, 13 October 1953

Morning Session – Chairman: H. G. Tremblay

"Design Features of Two Large-Scale Analog Computers on the West Coast"
  By S. Rogers, D. Abramis, Consolidated Vultee Aircraft Corporation
  Discussion of design objectives and decisions based on principal requirements
  of large-scale analog computers to be used in aircraft plants, with details
  of special features and operating experience of these facilities

"Development of a New Large-Scale Three-Dimensional Simulator"
  By J. Lehmann, RCA Laboratories
  Discussion of Dynamic Systems Synthesizer, an all-electronic computer that
  will eliminate limitations as to time scale; use of new punched-card tech-
  nique for programming; prospect of fast trouble-shooting and greater
  reliability than is present in electro-mechanical computers

"The Time-Sequence Controller for Automatic Operation of the Electronic Differential
  Analyzer"
  By G. R. Hansen, Jet Propulsion Laboratory – California Institute of
  Technology
  Time-Sequence Controller consisting of five precision intervalometers which
  operate switching mechanisms. Discussion of design and operation of various
  components, modes of operation of the entire device, circuits employed in
  basic elements, and types of problems which benefit by this facility.

"The Use of the Network Analyzer for Problems in Dynamics and Control"
  By S. W. Walsky, J. L. Burnside, North American Aviation, Inc.
  Comparison of techniques for mechanizing an amplifier-type analog computer
  and a network analyzer, illustrated by a problem in the dynamic stability
  of flexible aircraft under autopilot control.
"Raydac (Raytheon Automatic Digital Calculator)"
By LCDR J. C. Aller, USN, U. S. Naval Air Test Center
Description of the salient physical, electronic and logical features of the
RAYDAC compared to the same features of other large-scale digital calcula-
tors and details of effect of built-in checking features upon operation.

"Better Communication for Better Simulation"
By J. H. McLeod, Jr., Chairman, Steering Committee, Simulation Council
This talk advocates a closer affiliation between groups engaged in simulation.

Afternoon Session -

"Precision Potentiometer Setting Equipment"
By L. L. Gordon, Electronic Associates, Inc.
Description of design, construction, and performance of equipment for
setting large quantities of precision potentiometers such as are found in
the modern precision analog computer. This includes design of mechanical
clutch, keyboard-operated matrix system, design and construction of
precision resistance divider with necessary servo amplifiers, control
circuitry, etc.

"Electronic Zero Stabilization of D. C. Amplifiers"
By S. Sternberg, RCA Laboratories
Discussion of the application of an electronic chopper to D.C. amplifier
stabilization, and limited description of the structure of the chopper and
its electrical characteristics.

"Noise Generation for Analog Simulation"
By S. Sherman, Bell Telephone Laboratories and E. Lakatos, Hughes Research
and Development Laboratories
Description of a method for generating random noise for use in analog
simulation using a list of random numbers as primary source. The method
has the advantage of close control of the output and of offering easy
repeatability.

"An Electronic Function Generator for Use in Conjunction with Analog Computers"
By G. Gunas, CDC Control Services Inc.
Discussion of a method for the generation of non-linear functions by a
time division technique, and methods for making an electronic multiplier and
an electronic resolver.

"Optically Driven Airborne Chopper"
By J. Schwartz, R. Solomonoff, Avion Instrument Corporation
Discussion of considerations which led to the selection of electronic
components used for conversion of low-level D.C. signals to A.C., and
effects of modulating frequency and ambient temperature upon conversion
efficiency.

"The Application of a Magnetic Tape Recorder in Analog Computing"
By H. B. Belck, Rensselaer Polytechnic Institute
Discussion of "time-ratio modulation recording"; some circuit details of a
recording system using this modulation; applications of this recorder in
analog computing.

Visit to Typhoon Laboratory, Analytical and Computer Department 8:00 - 9:00 P.M.
U.S. Naval Air Development Center
Wednesday, 14 October 1953

Morning Session – Chairman: Professor F. J. Murray

"A New Analog Computer Technique for Determining System Transfer Function Coefficients"
By R. W. Brown, Sr., National Bureau of Standards
Discussion of the use of the analog computer in analyzing dynamical performance data and in obtaining required impulsive responses from transient or frequency data

"Application of Computer Techniques to Evaluation of Complex Statistical Functions"
By I. Pfeffer, R. R. Favreau, Hughes Aircraft Company
Discussion of statistical functions which are difficult or impossible to evaluate analytically without use of suitable source of low frequency noise and special switching amplifiers; generation and measurement of a Rayleigh fading signal experimental procedure for evaluating the probability function of interest

"The Automatic Computation of Stability Regions by an Analog Computer"
By F. W. Bratten, National Bureau of Standards
Discussion of a novel analog computer method for determining stability regions with respect to system parameters, and usefulness of this technique showing how any minimum damping constant, rather than zero damping, may be made the critical factor

"Analog Computers and Huyghen's Principle"
By V. Azgapetian, Servomechanisms, Inc.
Use of differential analyzers with geometric components to solve problems in variational calculus

"Checking Analog Solutions of Unstable and Complex Systems"
By W. P. Richmond, Jr., The Glenn L. Martin Co.
Discussion of methods of checking various linear, non-linear, and complex systems, affording an opportunity to locate errors, mistakes, or equipment malfunctions; applicability to simulation problems using actual equipment

Afternoon Session – Chairman: C. V. L. Smith

"Simulation Techniques Associated with a Digital Flight Control System"
H. Margolis, E. Weiss, J. B. Rea Company, Inc.
Description of overall aspects of problems associated with the simulation program of a digital flight control system designed to directly control the airframe of a fighter during normal flight as well as maneuvers. Discussion of aids in simulation of a given system (a filter system, etc.) by building special digital devices, and novel methods of converting from voltage to numbers, and vice versa

"Solution of a Heat Transfer Problem with the Electronic Differential Analyzer"
By A. G. Presson, Jet Propulsion Laboratory, California Institute of Technology
Description of the use of the electronic differential analyzer in the determination of the temperature distribution in a circular cylinder. Discussion of typical solutions, accuracy, and computing techniques.
"Simulation of Some Non-Linear Oscillators"
By F. O. Llano, Sandia Corporation
Discussion of heretofore unobtainable response curves for non-linear oscillators by electronic analog computer means, with illustration of a particular mechanical system and comparison of analog and hand results, using simplifying assumptions.

"Landing Gear Load Determination by Use of the REAC"
By J. W. Lincoln, Chance Vought Aircraft
Description of method of simulating a landing gear on the REAC so that dynamic landing loads may be obtained quickly.

"Use of the Analog Computer in Evaluating Integrals of the Form
\[ \int_0^\pi \sin^2 \theta \cos \theta \ J_\nu(A \sin \theta) \ e^{iC \cos \theta} \ d\theta \]
By V. L. LarwOTE, E. C. Licht, Willow Run Research Center
Discussion of a method of evaluation. Some properties of the integral.

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Except for the inevitable security foulup, we enjoyed the Typhoon Symposium more than any other we have attended. This might have been because we were more interested, or because it was pitched about our level, or because it really was the best. Nevertheless we got a lot out of it. For reasons of security and inadequate notes - we will not attempt any technical comments. The complete proceedings will be published by the Committee and copies can undoubtedly be obtained through them. Hereewith, however, some side remarks which may or may not be in order. Your editor's clearance was located in time for me to hear most of Admiral Hatcher's welcoming address. I am glad I heard the Admiral. If he wrote his talk, or even believes what he said, simulation has a powerful proponent.

Commander Keen, who opened the technical sessions, was in charge of the Typhoon computer at NADC until July of this year and had much to do with planning the Symposium. We were pleased when he announced that the interest of the Simulation Council in "non-physical" simulation, as expressed in the Newsletter, influenced their selection of the opening papers of both the morning and the afternoon sessions. Security precludes a discussion of these two papers here, but it seems to the writer that the men making these applications are pioneering in a field of vast possibilities.

We were interested in T. Lairson's statement that an optimum non-linear system cannot be designed because of the importance of history. I have on my desk a very convincing paper by E. Q. Smith of Virginia Polytechnic Institute (prepared while he worked at NADC) which states without qualification that "the best non-linear system is better than the best linear system". I would like to get these two together!

We were also glad to hear the Bennett-Favreau-Pfeffer paper on the adjoint computing method, which has been mentioned previously in these pages.

About this time in the proceedings it became evident that William Uplingco of NADC was not going to be present to deliver his paper, so your editor had to use his lunch hour to bone up on the project so he could pinch-hit. Then, forewarned by the failure of one of NADC's speakers to arrive, we called Mr. Tremblay's attention to the fact that if LCDR Aller didn't show up, the program...
as issued would have me following me. Now you may have your own opinion of one
John McLeod on the program, and the desirability of having two on successive days
might be in question. But there was no doubt at all about having a third follow
the second. A last minute emergency change was made. As a result your editor
presented his own talk - on the Simulation Council - Tuesday morning; and
changing hats, described the RAYDAR that afternoon.

The Tuesday morning session was opened as scheduled by Stan Rogers doing an
effective job of describing the big new Convair analog computers at San Diego and
Pomona. We were mildly surprised when Stan walked to the podium instead of Dov
Abrams, because Stan is usually the quieter of the two. We were even more
surprised, and pleased, when Stan's presentation kept even those of us who were
familiar with the facilities he described intensely interested throughout his
talk. When he had finished both he and Dov participated in one of the liveliest
discussions of the symposium.

In Tuesday's second talk J. Lehrmann gave us a preview of Typhoon's successor.
RCA's primary effort in this development seems to be the elimination of all
mechanical computing components. To this end they have developed an electronic
multiplier, the extra tubes and circuitry of which will be included in each
operational amplifier chassis. Standardization and flexibility are thus increased
because all amplifiers are alike and any of them are capable of multiplying.

To eliminate still other mechanical components from the computer, an electronic
"chopper" has been developed to replace mechanical choppers. In this device
photosensitive semi-conductors are excited by a flashlight bulb to chop the input
and output of the zero stabilizing amplifiers.

This most interesting development was described in more detail by S. Sternberg
in the afternoon session and, as if to underscore its importance, another paper
delivered by R. Solomonoff of Avion described a similar device.

The Avion "chopper" apparently differs from the RCA one principally in that it
uses a different photosensitive material and is excited by a neon light at
a higher frequency. We understand that this Avion device is available commercially
as a plug-in unit, but Mr. Solomonoff did not know the price.

In connection with the new computer (successor to Typhoon) RCA has also studied
various applications of cross-bar technique to eliminate patchboards. We were
interested to note that relays, which would make automatic connecting by punch-
tape or cords possible, seem promising.

Perfection and use of such a technique in combination with a method of automatic
potentiometer setting such as that described by L. L. Gordon of Electronic
Associates would allow completely automatic setup of analog computers.

And why automatic setup? Are we so lazy that we mind pushing a few hundred wires
in holes and twisting several dozen pots? Well maybe so, but the real importance
of automatic setup would be: (1) a tremendous reduction in the probability of
human error; and (2) decrease to a negligible amount in computer down time for
setup or changeover.

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Important intangible benefits to be derived from these symposia are the personal
contacts and the unscheduled meetings. One evening we had a dinner meeting to
discuss Flight Tablos, and of course there was much shop talk over cocktails
at other times.

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One such session with Dr. Jacobi of the General Electric laboratory in Schenectady and John Sharp of IRI-Endicott, during which we talked about multipliers, was particularly interesting. Dr. Jacobi seems to have investigated just about every means of analog multiplication, and Sharp is preparing a report on analog computation "to tell the IRI digital people what it's all about", he says. Between them your editor got brought up to date on the multiplier situation, but I'm afraid by the time I could interpret my notes to give the Newsletter readers the word the info would be obsolete. Such is progress in the analog field!

Another pleasant encounter was with Charles Cooremans, representative of the Société d'Electronique et d'Automatisme, our French subscriber. M. Cooremans' English was better than our French, but even then our communication was too difficult to make any great contribution to the computing art. We had no difficulty at all, however, in agreeing on oysters and white wine at Bookbinder's!

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The Thursday after the Symposium we went up to NADC to see the Typhoon (we missed the official visit in favor of the impromptu meeting on flight tables) and other facilities, and to call on my old friend Captain Grayson Merrill. Grayson is a strong advocate of simulation, and the inclusion of Environmental with Functional Simulation.

Speaking of Environmental Simulation, we took the opportunity to visit the large centrifuge at NADC where men have been subjected to accelerations to 17 g. Now there's an environment I don't care to experience!

Next day we visited Electronic Associates to see how they make some of the equipment we would like to have. After an interesting professional visit it developed that we were associating with a bunch of skin divers, and skin diving is our favorite sport. Went diving that afternoon with one of my new friends, and Mr. Adamson referred me to a skin diver in the salvage business, whom we later met in Miami. Good people to know, these EA men!

Next stop was IRI in Endicott where your editor was invited to address an engineering seminar on one of my favorite subjects - "Analog and Digital Computation - Competitive or Complementary?". Much interest was shown; in fact after a half-hour address I was kept busy for a full hour answering intelligent questions. Why is IRI, this giant in the digital field, so interested in analog computation? Don't know, but of course this seems like a very intelligent interest to us.

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On our way to the Florida Keys for the vacation part of our trip we made another business call, the most important of all, for this time we visited our boss's bosses, the Bureau of Aeronautics from whence all good things (GOD) came. Was pleasantly surprised at how much simulation has gained in favor there. In fact one group agreed that what they would like to see at a test and evaluation center (e.g., NADC) is a ground test facility where simulation (and other) techniques would be used to evaluate weapon systems and components completely before a missile is fired. Flight tests would then be made only to spot check the performance predicted by simulation! Boy, if we can ever develop such a facility we can all expect a tax cut.
We find it hard not to tell you about the wonderful skin diving off the Florida Keys and at Silver Springs, and the fun we had in New Orleans, but we are afraid these libraries have no funds for travelogues.

So we will only say that on our way home we stopped at White Sands and talked simulation with Bob Gilpin and Helmut Horne. The J. B. Rea Company is just finishing a study contract to advise them on the best way to set up a simulation facility for test and evaluation. Plans are to use it to support the flight test program, as is done at NASA.

I was particularly interested in one remark by Horne, who has been interested in simulation since his VI days. He says that there is one pattern which all concerned with simulation follow. At first every effort is made to include as many actual components as possible. Then, as confidence in simulation increases, more and more analogs are used, until finally no hardware is included at all. Interesting!

Commercial Computing Centers

As a result of the survey conducted by your Newsletter, Electronic Associates has decided not to establish a computing center on the West Coast at this time. They were very happy with the job we did for them (plug*) but decided the demand was not sufficient to warrant withholding the necessary equipment from their customers.

The J. B. Rea Company is planning a large installation in their new plant at 1723 Cloverfield Boulevard, Santa Monica, however. Although planned primarily for the use of his own company, Jim invites outside work.

We understand Rensselaer Polytechnic Institute also has time available on their analog computer.

Simulation Council Meeting - November

We wish to thank Mr. Verhoeven of Goodyear Aircraft for picking up the ball for us on the November meeting. He phoned us in New Orleans for the necessary information and then sent out notices which most of you in the Southern California area should have received.

Date: November 19, 1953
Time: 1:15 Pm
Topic: Noise
Place: Goodyear Tire and Rubber Co., Inc.
6701 South Central Avenue
Los Angeles 54, California

Parking for Simulation Council members in the Goodyear parking lot located on Central Avenue, just north of the plant. After the meeting, refreshments and a tour of the factory.

Subscriptions to the Newsletter

To subscribe to the Newsletter, send a check or money order payable to the Simulation Council, Post Office Box 731, Camarillo, California. The price is $6.00, to cover a one-year's subscription.

*Anyone else want a survey?