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Opening Remarks and Wozencraft Interdisciplinary Legacy

Reeves, Lawrence

Monterey, California. Naval Postgraduate School

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The John McReynolds Wozencraft Interdisciplinary Science & Engineering Colloquia



February 26, 2013

Opening Remarks and Wozencraft Interdisciplinary Legacy

Lawrence Reeves

President, AFCEA Monterey Bay Chapter

Dr. Dan C. Boger

Chairman, Information Sciences Department

Introduction of Guest Lecturer

Dr. Roger D. Melen

Lecturer, Stanford University, Electrical Engineering Department
Senior Advisor, Toyota Infotechnology Center

Turing, von Neumann, and Beyond ↑

A New Computing Machine That Addresses a Root Cause of *Malware*

Dr. Michael S. Fiske

Chief Executive Officer, Fiske Software, LLC



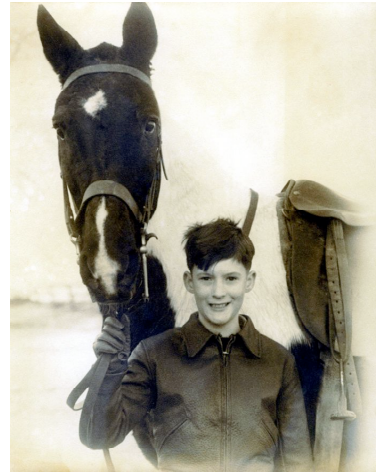
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Interdisciplinary Science & Engineering Colloquia



February 26, 2013

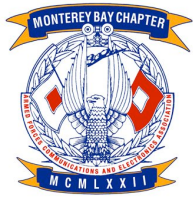


Courtesy Fran Wozencraft

“Wherever men associate, there is always one who, in all respects, stands head and shoulders above everyone else. Such a man is Jack, a student of the highest possible caliber of all subjects scientific and social, an exceptional athlete, skillful writer, and a fluent speaker. He possesses an agile mind which masters the theoretical as readily as it handles a situation requiring common sense.” (West Point Howitzer 1946)

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Contact: Lawrence. Reeves at LJReeves1012@gmail.com to request permission and offer comments, corrections, references, and additional materials.



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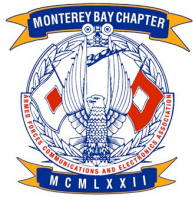
**Last time we met like this was in June 2010 with the
11th Secretary of the Air Force, Tom Reed and
SECDEF DTACCS Director Dick Shriver
They told us how the C3 graduate education program came to
NPS in 1977**



Courtesy Sam Reeves Photography 2010



Courtesy Lawrence Reeves 2010



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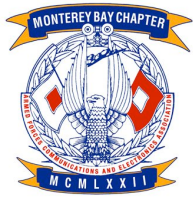


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US Navy Photo Javier Chagoya 2010

Dr. Rachel Goshorn and Dr. Robert Kahn (on the way to the US Open at Pebble Beach)



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Then we learned from Bob Kahn about his mentor:

“When I got to MIT I joined the Research Lab of Electronics (RLE).

The particular group that I was in was headed at that time by Jack Wozencraft, who subsequently went over to Project MAC, and then, I believe, after a short tour at Lincoln Lab went out to the Naval Postgraduate School.

I was at MIT for only a few years. I left in 1966 on a leave of absence, basically at the recommendation of Jack, who thought that it might be beneficial if I got a year or two of practical experience under my belt, since I was largely a mathematician.

That group had quite a bit of fundamental grounding in practical realities of engineering. **It was some of the best advice I ever got. I took a leave of absence in 1966 and went to Bolt, Beranek and Newman.”** (*birthplace of ARPAnet IMP, BBN Report 1822 in 1968*)



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Bob talked about Internet's future and Wozencraft June 16, 2010



US Navy Photo Javier Chagoya 2010



US Navy Photo Javier Chagoya 2010



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**The John McReynolds Wozencraft
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The Wozencraft Legacy Project research began in November 2009

**We discovered some of Jack Wozencraft's classmates
in January 2010**

And much more,



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GEORGE BUSH

June 1, 2010
for
June 17, 2010

Barbara and I send greetings to all who are gathered for The John McReynolds Wozencraft Memorial Service.

This service is fitting tribute to a brilliant man, a true patriot, and a wonderful human being. Even back in the early '40s, when Barbara and I first met Jack Wozencraft, we knew he would make great and lasting contributions to our country. He exceeded our expectations; and as for Barbara and me personally, well, Jack made the introduction that resulted in a marriage that is now in its 66th year.

Barbara and I congratulate the honorees at this special event, and we send our very best wishes to Jack's entire family. We share your pride in this great American.

Sincerely,



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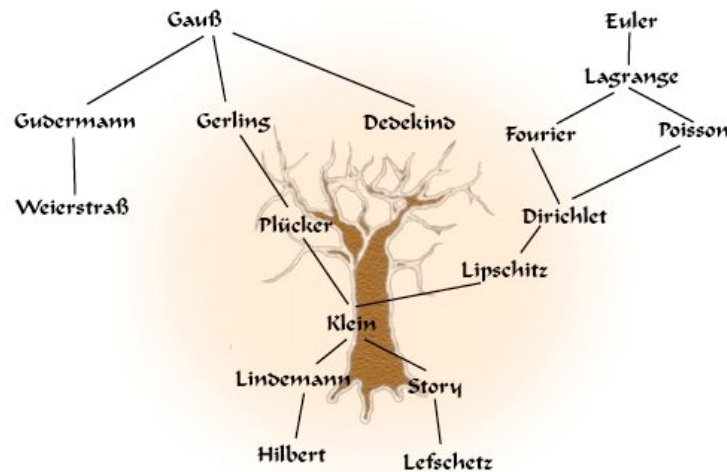
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Mathematics Genealogy Project – Wozencraft Doctoral Students



John McReynolds Wozencraft

[MathSciNet](#)

Sc.D. Massachusetts Institute of Technology 1957



Dissertation: *Sequential Decoding for Reliable Communication*

Advisor: [Robert Mario Fano](#)

Students:

Click [here](#) to see the students ordered by family name.

Name	School	Year	Descendants
Thomas Kailath	Massachusetts Institute of Technology	1961	457
James Massey	Massachusetts Institute of Technology	1962	56
Robert Kennedy	Massachusetts Institute of Technology	1963	36
G. David Forney, Jr.	Massachusetts Institute of Technology	1965	2
James Morris, Jr.	Massachusetts Institute of Technology	1969	7

According to our current on-line database, John Wozencraft has 5 [students](#) and 562 [descendants](#).



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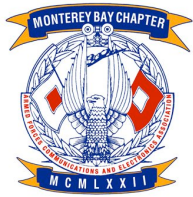


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- MIT DOCTORAL SUPERVISORS AND COMMITTEE WERE COMPUTER AND INFORMATION THEORY PIONEERS ROBERT M. FANO WITH PETER ELIAS, CLAUDE E. SHANNON, AND JEROME B. WEISNER
- MIT ScD 1957 “*SEQUENTIAL DECODING FOR RELIABLE COMMUNICATIONS*” MAY 1957, TR-325
- DISSERTATION RESEARCH JOINTLY FUNDED BY ARMY SIGNAL CORPS, OFFICE OF NAVAL RESEARCH, AND USAF OFFICE OF SCIENTIFIC RESEARCH

Abstract

Shannon's coding theorem for noisy channels states that it is possible to communicate information, with arbitrarily small error, at any rate of transmission less than the channel capacity. The attainable probability of error has previously been bounded as a function of capacity, transmission rate, and delay. This investigation considers the behavior of a new parameter, the average number of decoding computations. A convolutional encoding and sequential decoding procedure is proposed for the particular case of the binary symmetric channel. With this procedure, the average number of decoding computations per information digit can be constrained to grow less rapidly than the square of the delay. The decoding process converges for constant rates of transmission that are not too close to capacity. Although it has not been possible to prove this rigorously, it appears that the probability of error decreases exponentially with delay, and is essentially optimum for transmission rates near the limit of convergence. It also appears that the sequential decoding technique can be extended to more general channels.



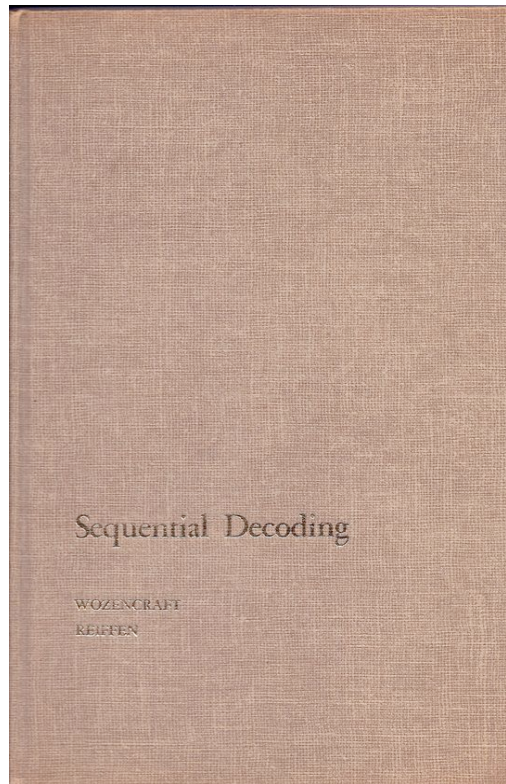
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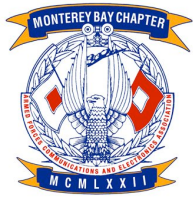


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Wozencraft Invented Sequential Decoding in 1957



MIT Monograph No. 10, August 1961 (74 pp)



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PREFACE

“For some years coding theory has played an increasingly central role in the deliberations of communication system engineers. Its importance stems from the bound that it establishes on what can and cannot be accomplished. The authors have recently been engaged in investigating the problem of designing systems whose performance approaches these bounds. The primary objective of this monograph is to report upon this research.”

“ The authors are happy to have this opportunity to express their gratitude to Professors Peter **Elias**, Robert M. **Fano**, and Claude E. **Shannon**. Without their inspiration, guidance, and occasional goading, this work would have been neither undertaken nor accomplished.” *John M. Wozencraft & Barney Reiffen, Cambridge, Massachusetts, August 1960*



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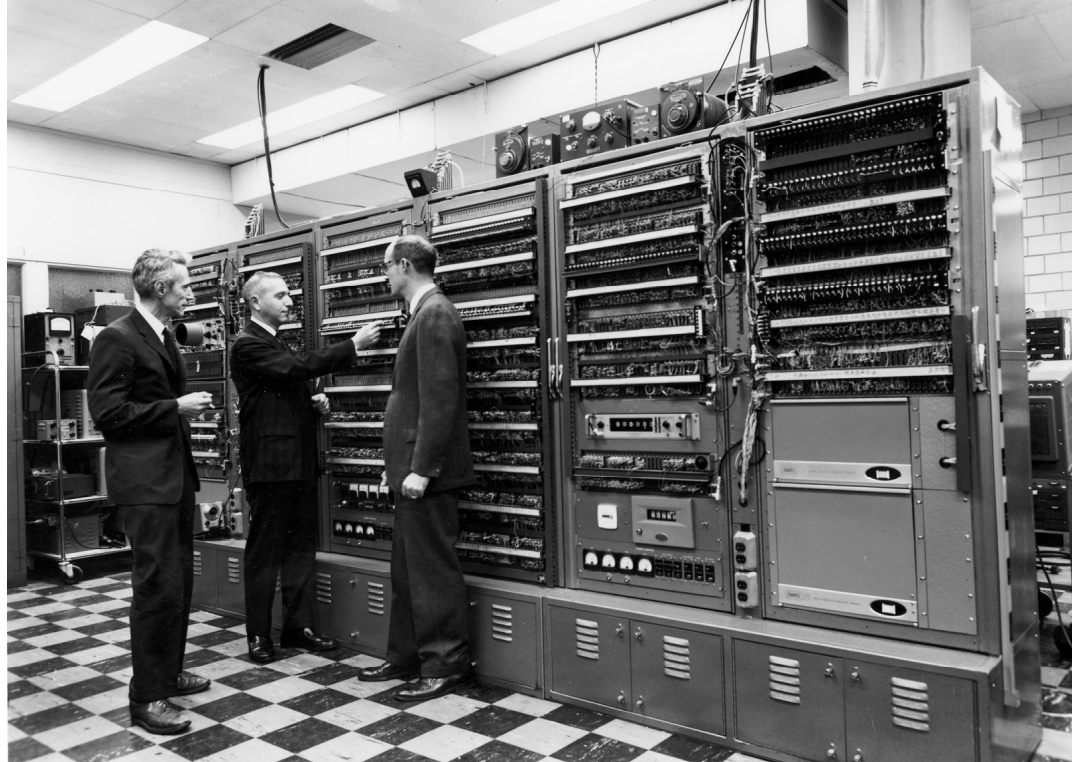


Image courtesy of the late Paul Rosen and Frances T. Wozencraft

Dr. Claude E. Shannon, Mr. Paul Rosen, and Dr. John M. Wozencraft 1961 at MIT Lincoln Laboratory

PROOF OF CONCEPT ENGINEERING MODEL FOR SEQUENTIAL DECODING

Application of Sequential Decoding to High Data Rate Communication on a Telephone Line 9.6 kb/s Full Duplex



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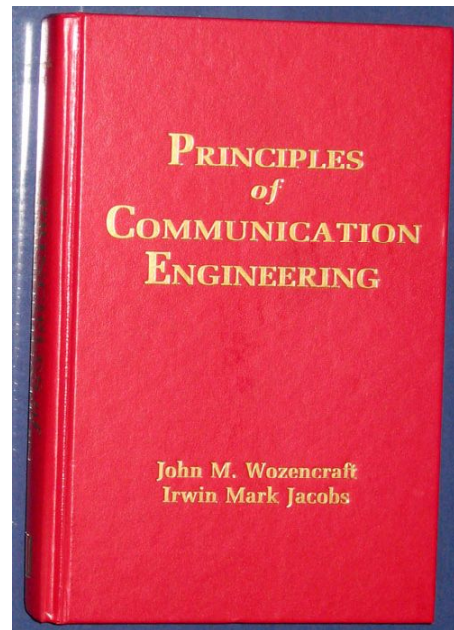
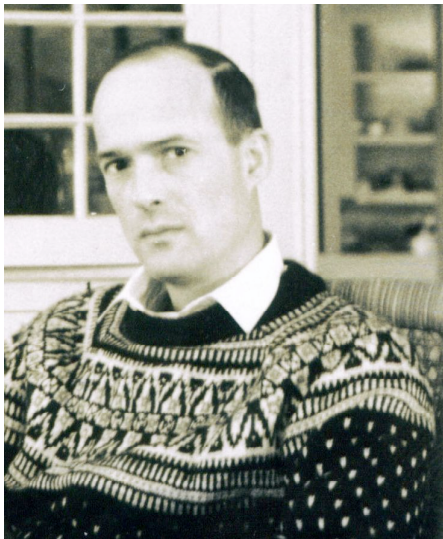
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Wozencraft-Jacobs Text Book Still-in-Use and Sold 4,046 Copies 1990-2011

Co-authored in 1961 on Fran's Dining Room Table and Published in 1965





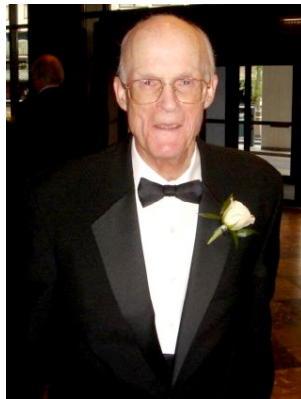
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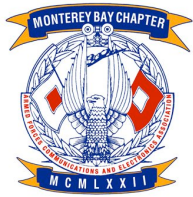
INSTITUTE OF ELECTRICAL & ELECTRONIC ENGINEERS ALEXANDER GRAHAM BELL MEDAL 2006



John M. Wozencraft's pioneering work on error-correcting codes provided one of the foundations for the design of reliable digital transmission systems over the past 50 years. Coding is an integral part of today's nearly error-free communications systems, including deep-space communication, the Internet and next-generation mobile telephony.

Based on the notion of random coding, sequential decoding was the first error-correcting algorithm whereby arbitrarily-accurate fixed-data-rate communication could be attained over noisy transmission channels with reasonable computational complexity. This approach paved the way for other algorithms that ultimately revolutionized the communications industry. It was a critical conceptual milestone in the evolution of error-correction coding from abstract mathematics to today's palette of computationally practical error-correction.

MIT Professor Robert G. Gallager, a student and colleague nominated Wozencraft for this prestigious award – “*time to recognize his work*”



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Courtesy of James Massey c. 2006

Dr. James L & Lis Massey, Dr. John M. & Frances Wozencraft, and Sarah & Dr. Thomas Kailath
(Kailath and Massey were Wozencraft's doctoral students No. 1 (1961) and No. 2 (1962) at MIT)



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WOZENCRAFT'S MIT/LINCOLN LABORATORY DOCTORAL STUDENTS AND COLLEAGUES INFORMATION THEORY, COMMUNICATIONS, COMPUTERS, ARTIFICIAL INTELLIGENCE, AND INTERNET

Norman **Abramson**

Vannevar **Bush***

Elwyn R. **Berlekamp**

Amar G. **Bose**

Gordon S. **Brown***

Milton U. **Clauser***

Wilbur B. **Davenport, Jr.***

Gerald P. **Dinneen***

Peter **Elias***

Jerome I. **Elkind**

Arthur **Evans Jr.**

Robert M. **Fano**

G. David **Forney, Jr**

Robert G. **Gallager**

Richard W. **Hamming***

Irwin M. **Jacobs**

Frederick **Jelinek***

Robert E. **Kahn**

Thomas **Kailath**

Robert S. **Kennedy**

Leonard **Kleinrock**

Robert W. **Lucky**

James L. **Massey**

Marvin L. **Minsky**

James H. **Morris, Jr.**

Bernard J. **Pankowski***

Lawrence G. **Roberts**

Paul **Rosen***

David J. **Sakrison***

Claude E. **Shannon***

Louis D. **Smullin***

Ivan E. **Sutherland**

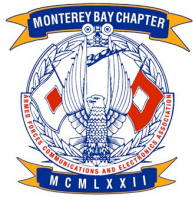
Andrew J. **Viterbi**

Norbert **Weiner***

Jerome B. **Wiesner***

Jacob **Ziv**

* deceased



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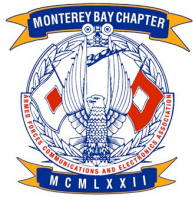


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SPECIAL AFCEA QUARTERLY NPS ELECTRICAL & COMPUTER ENGINEERING AWARD MARCH 16, 2010



**VADM Daniel Oliver (NPS President), Dr. Thomas Kailath (Stanford), Dr. Hersch Loomis (NPS Professor)
LT Nathan Geisinger, USN (MSEE and Engineer Degrees), John Sanders (NPS Knox Library)**



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THE WOZENCRAFT LEGACY PROJECT FIRST MILESTONE, MARCH 16, 2010



Dr. Thomas Kailath (Stanford University) and LT Nathan Geisinger, USN



The John McReynolds Wozencraft

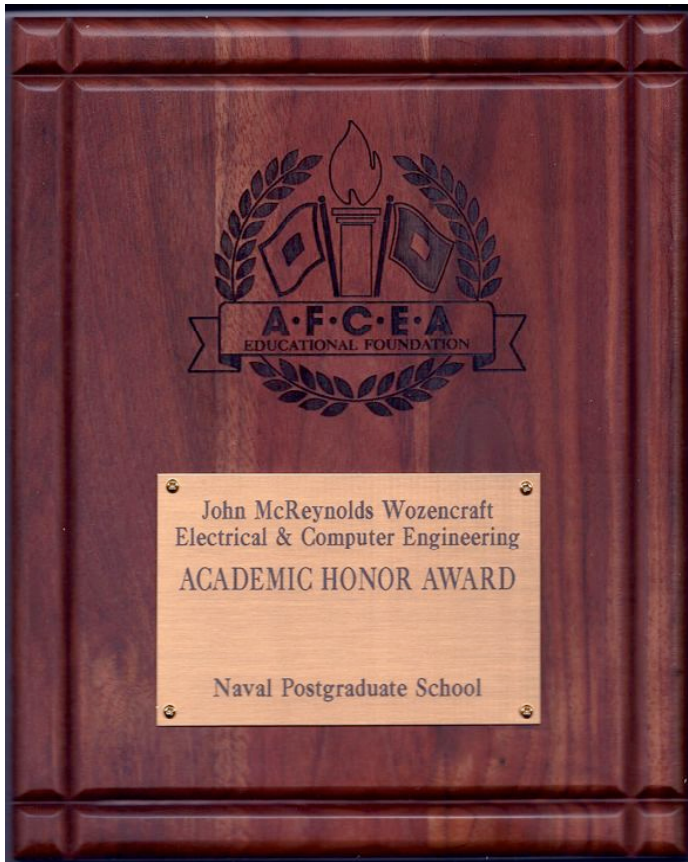
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THE WOZENCRAFT LEGACY PROJECT SECOND MILESTONE MAY 2010 – RENAMING THE AWARDS



PLAQUE PLACED IN TIME CAPSULE MAY 27, 2010

During the Naval Postgraduate School Centennial Year, 2009-2010, the Armed Forces Communications and Electronics Association (AFCEA) dedicated its quarterly student academic achievement award in honor of the late Dr. John (Jack) Wozencraft, who invented sequential decoding during his early career at the MIT and, in the 1970's, developed two innovative interdisciplinary programs at the Naval Postgraduate School. These educational programs -- Antisubmarine Warfare (ASW) and Command, Control and Communications (C3) – were the first of their kind in the nation. Dr. Wozencraft was NPS Dean of Research from 1972-1974 and founding Chairman of the Command, Control and Communications Academic Group 1977-1985. He was awarded the title of NPS Distinguished Professor in 1985. Dr. Wozencraft was also awarded the Institute for Electrical and Electronics Engineers Alexander Graham Bell Medal in 2006. On June 8, 2010, the Hon Thomas C. Reed, Secretary of the Air Force under President Gerald Ford and Director of the National Reconnaissance Office under President Jimmy Carter, will present the first John McReynolds Wozencraft Academic Honor Award. The plaque is identical to the centennial time capsule plaque. Secretary Reed will also present the first annual Wozencraft Joint Command, Control, Communications, Computing, and Intelligence (C4I) award on June 8, 2010. On June 17, 2010, Dr. Irwin M. Jacobs, Chairman of the National Academy of Engineering and coauthor with Dr. Wozencraft, *Principles of Communications Engineering*, will join AFCEA Regional Vice President Robert B. Landgraf to present AFCEA's Lifetime Achievement Award to Mrs. Frances Wozencraft. This will be the 8th presentation of this award in AFCEA's 65-year history. The Hon Richard H. Shriver, former Assistant Secretary of the Treasury, who directed the establishment of the initial C3 program at NPS as Director of Defense Telecommunications, Command & Control Systems, will assist Mr. Landgraf in the presentation.



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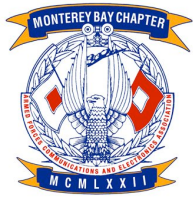
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**AFCEA DISTINGUISHED LIFETIME MEMBER SINCE 1947
JOHN M. WOZENCRAFT
POSTHUMOUSLY PRESENTED LIFETIME ACHIEVEMENT AWARD
8TH IN HISTORY OF AFCEA SINCE 1946**





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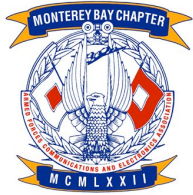


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**THE 119TH RECEIPT MARCH 19, 2013 OF THE
JOHN MCREYNOLDS WOZENCRAFT
ELECTRICAL & COMPUTER ENGINEERING ACADEMIC HONOR AWARD**



LT. WILLIAM R. FLEMING, U.S. NAVY



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VON NEUMANN'S ADVICE TO SHANNON

When Shannon first derived his famous formula for information, he asked von Neumann what he should call it and von Neumann replied *"You should call it entropy for two reasons: first because that is what the formula is in statistical mechanics but second and more important, as nobody knows what entropy is, whenever you use the term you will always be at an advantage!"*



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QUIZ

ORDERS: Let a word (40 **bd**) be two orders

each order = $C(A)$ = Command (1-10, 21-30 • Address (11-20, 31-40)

WHAT DOES **bd** stand for?



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Recognition and Acknowledgements

Monterey Peninsula College

Spring Hill Advanced School

Ocean Alternative School

Ocog, Inc.

Monterey High School JNROTC

Intel Corporation/McAfee

Stanford University School of Engineering

OpalSoft, Peter Verbica, and Brian Grossi



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About Roger Douglas Melen, PhD

**Networked Microcomputers
(1980s)**

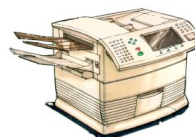
Cromemco Microcomputer Systems
"Tomorrows Computers Today"

Cromemco

1976-1988

Networked Office Appliances (1990s)

Canon Research Center America
Office Networking Software
Skunk Works



Canon

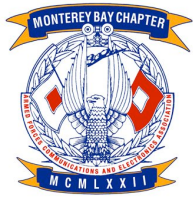
1990-2001

**Networked
Automobiles
(Current)**

ToyotaInfoTechnologyCenter USA
Connected Car Skunk Works

TOYOTA

2001-Present



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ABOUT MICHAEL STEPHEN FISKE

SANTA BARBARA NATIVE

PARENTS AND FAMILY FROM DAYTON, OHIO

**GREAT GRANDFATHER WILL OHMER
INVENTOR OF ORDNANCE FUZES AND TRANSMISSIONS**

**WWII MANUFACTURING
ASSOCIATED WITH WRIGHT BROTHERS**

and

**FRANK STUART PATTERSON, LT ARMY
(KILLED 1918 IN CRASH AT WRIGHT FIELD)**



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Courtesy Fiske Family

Army Officer (TBD), Mrs. Ohmer, Will Ohmer with Frank Stuart Patterson and a Wright Brother



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**Attended Stanford University
Biology emphasis on Neurobiology
Phi Beta Kappa Junior Year**

**Northwestern University Institute for Learning Sciences
MS Computer Sciences
Professor Roger Shrank**

**Northwestern University
PhD Mathematics
Non-Autonomous Dynamical Systems – Neural Computation
Professor Don Saari, Supervisor**

IBM

Startup Companies Biogy, Fiske Software, and Patents

AEM Concept Started in 2001