

Donald F. Hanson, Ph.D., P.E.

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Electrical and Electronics Engineer

1. Research and Development Engineer
2. Building Systems Integration Engineer

Witwright Institute:

Donald F. Hanson, Ph.D., P.E., PLT, is President and Owner of Witwright Institute, LLC based in Eden Prairie, MN. Witwright Institute offers:

- Research / Modeling of Real World Problems using Applied Engineering
- Building Electronics Systems Design, Integration and Installation.
- Renewable Energy Systems, including Conservation, Solar, and Wind.
- Educational materials for technology transfer to engineers, technicians, and the public.
- Mentorship and training in advanced applications of RF and microwave circuits, digital, video, and analog electronics, and antennas
- Consulting on RF/Antennas/Analog/Digital Electronics

Licenses for Public Practice:

- **Professional Engineer (PE)**, Minnesota License Number 43083.
Electrical and Computer Engineering overall emphasis
Electronics, Controls, and Communications specialized emphasis
- **Power Limited Technician (PLT)**, Minnesota License PL11116.

Professor and Educator at the following Universities:

- **University of Mississippi**
- **Syracuse University**
- **Iowa State University**
- **University of Minnesota**
- **Norwegian University of Science and Technology (NTNU)**

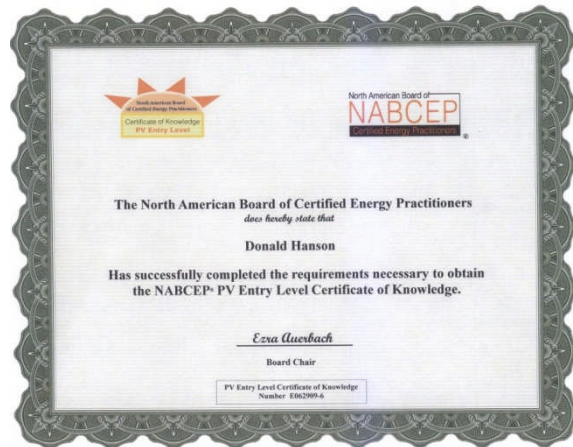
Education (University of Illinois at Urbana-Champaign)

<i>Degree</i>	<i>Specialty</i>	<i>Year</i>	<i>Major</i>
Ph. D.	Electromagnetic Theory & Mathematics (Minor)	1976	Electrical Engineering Mathematics Minor
M.S.	Analog, Video & Digital Electronics	1972	Electrical Engineering
B.S.	Computer Software	1969	Electrical Engineering

CERTIFICATIONS (Solar/Renewable):

Certification	Sponsor
NABCEP Photovoltaic (PV) Entry Level Certificate of Knowledge, June 2009	North American Board of Certified Energy Practitioners (NABCEP)

Actively Pursuing Full NABCEP Certification, including Master Electrician License



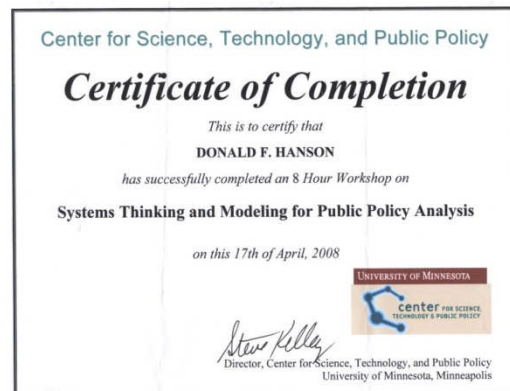
Workshops (Center for Science, Technology, and Public Policy, U. of Minn.):

Workshop	Sponsor
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Green Chemistry in Minnesota: Opportunities and Challenges for Leadership (May 2008)



Systems Thinking and Modeling for Public Policy Analysis (April 2008)



System Dynamics Workshop: David Ford (October 23, 2008)	Center for Science, Technology and Public Policy, University of Minnesota
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Innovation 2008 Conference: Renewing America through Smarter Science & Technology Policy (October 20 & 21, 2008)	Center for Science, Technology and Public Policy, University of Minnesota
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CERTIFICATIONS (Building Systems Integration):

Certification		Sponsor
CEDIA Professional Designer (CPD)		Custom Electronic Design and Installation Association (CEDIA)
CEDIA Certified Instructor (CCI)		Custom Electronic Design and Installation Association (CEDIA)
CEDIA Professional Installer Level 1 (CPI 1)		Custom Electronic Design and Installation Association (CEDIA)
HomeWorks Installation and Programming Qualification		LUTRON Lighting Control Institute, Lutron Electronics Co., Inc.
TV-RF Installation & Calibration Certification		RF Training Institute (RTI)
ISF Technician/Dealer Digital Video Calibration		Imaging Science Foundation (ISF)
Acoustical Design & Calibration Certification		Home Acoustics Alliance (HAA)

MANAGEMENT TRAINING (Engineering Leadership and Research):

Training	Sponsor
Making a Transition to Manager (Dec. 2006)	IEEE Twin Cities Section
Project Management Workshop (Sept 2008)	IEEE Twin Cities Section

UNIVERSITY INSTRUCTION AND RESEARCH EXPERIENCE:

- ◆ **Research in Elect. Engr. Applications, including Antennas, RF & Microwaves, Digital Systems, Computer Architecture, Communications and Education.**
- ◆ **RF and Microwave Measurement Expert up to 50GHz**
- ◆ **Expert Witness in Satellite Dish Antennas and Controls**

◆ **Courses and Laboratories taught: (Mississippi, unless noted)**

Courses (Undergraduate)

Electric Circuits (Iowa State)	*Advanced Digital Systems
Electric Circuit Theory	Modulation, Noise and Communications
Analog Circuits and Systems (Syracuse)	Transmission Lines, Fields, and Waves (Minnesota)
Electronics Engineering (Iowa State)	Introduction to Electromagnetic Fields (Iowa State)
Electronics Models and Circuits	Theory of Fields
Principles of Digital Systems	Electromagnetic Theory I, II
Solid State Devices	Senior Design I, II

Laboratories (Undergraduate)

*Electronics Laboratory	*Advanced Digital Systems Laboratory
Electric Circuit Laboratory	*Microprocessor Systems Engineering Lab
Electronics Engineering Lab (Iowa State)	High Frequency and Microwave Laboratory
Digital Systems Laboratory	

Courses (Graduate)

Microwave Engineering	Passive Microwave Circuits
Introduction to Antennas	Active Microwave Circuits
Advanced Electrodynamics	Numerical Methods In Electromagnetics
Advanced Electromagnetic Theory	Digital Circuit Design (Syracuse)
* These courses were my own original creations	

PROFESSIONAL MEMBERSHIPS:

- ◆ **IEEE**, Institute of Electrical and Electronics Engineers.
- ◆ **NSPE**, National Society of Professional Engineers
- ◆ **MRES**, Minnesota Renewable Energy Society
- ◆ **SCTE**, Society of Cable Telecommunications Engineers.
- ◆ **NSCA**, National Systems Contractors Association.
- ◆ **CEDIA**, Custom Electronic Design and Installation Association, 2006 - 2008.

THESIS AND DISSERTATION

Dissertation

- Ph.D. Dissertation: **An Investigation of the Current Source-Function Technique for Solving Problems of Electromagnetic Scattering**, Department of Electrical Engineering, University of Illinois, 1976.

Thesis

- M.S. Thesis: **Outlining and Shading Generation for a Color Television Display**, Department of Computer Science, University of Illinois, 1972

FELLOWSHIPS

- Research Fellowship, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ 07703, 1989 U.S. Army Summer Faculty Research and Engineering Program.
- Research Fellowship, Electronics Technology and Devices Laboratory, Fort Monmouth, NJ 07703, 1988 U.S. Army Summer Faculty Research and Engineering Program.
- Research Fellowship, Rome Air Development Center, Hanscom AFB, Massachusetts 01731, 1986 USAF-UES Summer Faculty Research Program
- Research Fellowship, Rome Air Development Center, Hanscom AFB, Massachusetts 01731, 1985 USAF-UES Summer Faculty Research Program
- Research Fellowship, NSF 1982 Industrial Research Participation Program at General Electric ELAB, Syracuse, New York, Summer, 1982
- Research Fellowship, Air Force Weapons Laboratory, 1979 USAF-SCEEE Summer Faculty Research Program, Kirtland AFB, New Mexico, 87117

PROFESSIONAL EXPERIENCE (SUMMARY)

◆ Witwright Institute, LLC. May 2004 - present

President and Owner, Witwright Institute, LLC, Eden Prairie, MN 55344. New Startup business: May 6, 2004.

Consulting with clients to implement advanced electronics systems, including digital, video, and analog electronics, RF and microwave circuits, and antennas; Research and Instructional Development in Engineering; Mentorship and training in advanced applications of digital, video, and analog electronics, RF and microwave circuits, and antennas. Books and educational materials for technology transfer to engineers, technicians, and the public.

Go to: <http://www.witwright.com/>

◆ Patterson, Thunte, Skaar & Christensen, P.A. 2006 (consultant)

Expert Witness for King Controls, a leading manufacturer of mobile satellite antenna systems. Patent infringement case against KVH INDUSTRIES, INC., Patterson, Thunte, Skaar & Christensen, P.A. (Patent Law Firm). Expert in satellite television dish antennas, and automated dish positioning systems.

◆ University of Minnesota, Minneapolis, MN. Fall Semester 2005.

Adjunct Professor, Department of Electrical and Computer Engineering, Concentration: **EE 3601: Transmission Lines and Electromagnetics.** Also Senior Design professor.

◆ University of Minnesota, Minneapolis, MN. Spring Semester 2003.

Adjunct Professor, Department of Electrical and Computer Engineering, Concentration: Senior Design, Electronic Seeing Eye Wand for the Blind, 6 Students.

◆ HEI, Inc. Sept. 2001- March 2002

Senior RF Engineer, HEI, Inc., Victoria, MN, 2001-2002. Broadband Microwave Measurements using Vector Network Analyzers 8510 and 8722. Calibration techniques for Broadband microwave/millimeter wave measurements.

◆ University of Mississippi June 1977- Aug. 2001

Associate Professor/Assistant Professor: Department of Electrical Engineering. Developed the microprocessor, computer architecture courses and electronics laboratory (1977-84), taught courses in electromagnetics, microwave circuits, antennas, digital systems, electronics, computer aided design, communications, solid state devices, senior design, and special functions. Did research in electromagnetics and digital systems, including microprocessor education.

➤ Go to: <http://www.ee.olemiss.edu/hanson/hanson.html>

➤ Go to: <http://www.ee.olemiss.edu/faculty.asp>

◆ NTNU (Norwegian University of Science and Technology) Aug 1997- Aug 1998

Invited Guest Professor, School of Electrical Engineering and Telecommunications, Department of Telecommunications, Norges teknisk-naturvitenskapelige universitet (NTNU) {Norwegian University of Science and Technology}, Trondheim, Norway. Sabbatical Leave 1997-98. This was a half-time academic year, full time summer, salaried position. Concentration: Wide Band Radio Access (WIRAC) project of the Department of Telecommunications at NTNU.

Concentration: 4th generation wireless communications, Ka-band active MMIC's, and Multi-media Satellite Digital Radio.

◆ U. S. Army Research Laboratory 1990-1991

Technical Staff, Microwave Group, U.S. Army LABCORP Electronics Technology and Devices Laboratory, SLCET-MP, Fort Monmouth, NJ (Now Army Research Laboratory). Sabbatical leave 1990-91. This was a half-time academic year, full time summer, salaried position. Concentration: MIMIC Hardware Description Language (MHDL) project. Wrote a library of 32 special functions in VHDL. Also participated in development of the MHDL Requirements Document.

◆ Syracuse University 1983-1984

Visiting Associate Professor of Electrical and Computer Engineering, Department of Electrical and Computer Engineering, Syracuse University, Syracuse, New York, Sabbatical Leave, 1983-1984. This was a half-time academic year salaried position. Concentration: Electronics.

◆ Iowa State University 1976-1977

Full time Faculty position teaching electronics and electromagnetics.

◆ University of Illinois 1974-1976

Digital Electronics Laboratory Instructor

◆ University of Illinois 1973-1974.

Lecturer in Architecture, Concentration: Lighting and Wiring

◆ University of Illinois 1971-1973.

Teaching Assistant in Electrical Engineering, graded courses, taught electronic design laboratory and built digital IC tester for a laboratory

◆ **University of Illinois** 1969-1971.

Research Assistant in Computer Science (M.S. Thesis), Designed and built part of a color graphics system: The Tricolor Cartograph

◆ **University of Illinois** 1968-1969.

Systems Programmer for Illiac IV Project, Wrote CONVERT/TWS for the Translator Writing System Group

ADDITIONAL EDUCATION

- NABCEP-Solar PV-Certificate of Knowledge, June 2009, Saint Paul College, June 22-29, 2009; Tested and Obtained NABCEP Solar PV Entry Level Certificate of Knowledge.
- HomeWorks Installation and Programming Qualification, LUTRON Lighting Control Institute, Jan 8-11,2007
- Residential Integration Business School, DI Partner, Oct. 19-21, 2006
- Residential Integration Design School, DI Partner, Dec. 11-15, 2006
- Residential Integration Installation School , DI Partner, Jan. 2-6, 2007
- Iowa DTV Symposium 2006, Iowa Public Television, Oct. 2-5, 2006
- LONMARK Sessions 2007, LONMARK International, June 26, 2007
- The Time is Right for Intelligent Buildings, Building Intelligence Tour, Jan. 25, 2006
- DaVinci technical seminar, Texas Instruments (TI), DaVinci digital signal processor training, networked audio/video applications, June 15, 2006.
- Participated in ENGR 597, *Introduction to Radar*, at U. Miss.
- Participated in ENGR 597, *Introduction to Digital Signal Processing*, at U. Miss.
- Participated in ECE 8223, *Analog CMOS IC Design*, from Miss. State U.
- *Enhancement of Faculty Design Capabilities*, NSF-SMU two-week short course, July 30 - August 11, 1995, Southern Methodist University, Dallas, TX.
- *Technological Opportunities & Challenges in Higher Education*, A Conference for Institutions of Higher Education (IHL of Mississippi), Engineering School Representative, April 21 & 22, 1995.
- *Microcomputer and Minicomputer Graphics*, NSF Chautauqua Short Course, Engineering School Participant, March 6-8, 1985, Christian Brothers College.
- *A Seminar on Teaching*, Center for Instructional Development, Syracuse University, Feb. 10, 1984.
- *Micro/Minicomputer Software Development*, National Engineering Consortium, April 30-May 2, 1978, St. Charles, Illinois
- *Modern Signal Processing Design Techniques*, National Engineering Consortium, May 3-5, 1978, St. Charles, Illinois
- *NSF Chautauqua Short Course on Microprocessors*, National Science Foundation, November 17-18, 1977 and March 2-3, 1978, Memphis, Tennessee

HONOR SOCIETIES

- *Tau Beta Pi* Engineering Honorary (Recording Secretary, U. of Ill. Chapter, 1968)
- *Sigma Tau* Engineering Honorary
- *Eta Kappa Nu* Electrical Engineering Honorary
- *Sigma Xi*, The Scientific Research Society

GOVERNMENT RESEARCH AND INDUSTRIAL CONSULTING ACTIVITIES

- U.S. Army Research Laboratory, Ft. Monmouth, NJ. Consultant on MIMIC Hardware Description Language (MHDL) project.
- U.S. Army, ETDL, Ft. Monmouth, NJ. Wrote a library of 32 special functions in VHDL. Also participated in development of the **MHDL Requirements Document** and wrote several white papers supporting the MHDL project, including:
 1. *Quantitative Concepts About the Four Dimensions: Hierarchy, Abstraction, Alternatives, and Views.*
 2. *Symbolic Computation in MHDL.*
 3. *Generalized Transfer Functions in MHDL.*
- Member, *IEEE SCC-30* (Standards Coordinating Committee) on Analog Hardware Description Languages, 1991-1995.
- Member, IEEE VHDL Mathematical Package Design Team, *IEEE Standard P1076.2*, VHDL Math Package, 1991-present. This was based on my VHDL math package written in 1990. The team consists of Donald F. Hanson (University of Mississippi), Jose Torres (VHDL), Chuck Swart (Analogy), and Alex Zamfirescu (Intergraph). IEEE Standard VHDL Language Mathematical Packages (Math_Real and Math_Complex), IEEE Std P1076.2-1995, IEEE, New York, NY, 1996. Note: This VHDL Math Package was adopted from my original work by this committee and has been voted an official IEEE Standard P1076.2. I am one of the authors of this standard. Approved 19 September 1996, 36 pages, comes with a floppy disk with the software.
- Member, IEEE Standards Committees and DASCs. VHDL 1076.1 analog extension to VHDL, etc. 1991-present.
- ERGON, Inc., Jackson, MS. Consulting on electromagnetic depth measurement meter using radar.
- Advanced MicroElectronics Division of ITD-Jackson, received gift of flat-bed Plotter for Integrated Circuit Design, February 28, 1996, Donald F. Hanson and Robert Khayat.
- Dielectric Resonators Short Course, University of Mississippi, University, Mississippi. Wrote 57 pages of notes on *Microwave Resonators*.
- General Electric Company, Syracuse, New York. Design and layout of portions of a VLSI CMOS integrated circuit to interface to a 6502 microprocessor and to do parallel processing of matrices of 1's, 0's, and -1's by rows and columns
- Commodore/MOS Technology, Norristown, Pennsylvania. Analyzed the detailed operation of the 6502 microprocessor
- Synertek, Inc., Sunnyvale, California. Analyzed the detailed operation of the 6520 PIA and wrote a paper on it.

- Texas Instruments, Inc., Midland, Texas. Participated in the evaluation of the pre-production prototype of their *Speech Education Module* for the speech Synthesis Division. My students are using TI speech synthesis techniques and the 6502 microprocessor to design systems to help the vocally handicapped and mentally retarded "speak." Due to my efforts, TI has donated speech processing equipment to the University of Mississippi.
- National Microtech, Inc., Grenada, Mississippi. Developed microprocessor control of the aiming function for receive-only satellite earth stations. Used 6502 microprocessor
- Harper and Row Publishers, New York, New York. Reviewer for Sydney B. Newell's 1982 text **Introduction to Microcomputing**. My name appears in preface
- Electrical Engineering Department, University of Mississippi. Developed solderless interfacing unit for the AIM-65 microcomputer which uses a 6502 microprocessor. Wrote two papers in educational journals about this approach to microprocessor education
- Fundamentals of Numerical Solution Methods in Electromagnetics Short Course, University of Mississippi, University, Mississippi. Wrote 73 pages of notes on *Numerical Analysis Techniques in the Moment Method*.

SHORT COURSE LECTURER

- *A Three-Day Short Course on Dielectric Resonators*, University of Mississippi, University, MS, Oct. 29-31, 1986
- *Dielectric Resonators Short Course*, University of Mississippi, University, MS, Spring 1985
- *Fundamentals of Numerical Solution Methods in Electromagnetics Short Course*, University of Mississippi, University, MS, Fall 1984
- *Fundamentals of Numerical Solution Methods in Electromagnetics Short Course*, University of Mississippi, University, Mississippi, Spring 1982

BOOKS

- Hanson, Donald F., *Microwave Resonators*, Chapter 2 of **Dielectric Resonators**, Kajfez, D. and Guillon, P., eds. 3rd Edition, Atlanta, GA: Noble Publishing Corporation, 1998.
- Hanson, D. F., *Microwave Resonators*, Chapter 2 of **Dielectric Resonators**, Kajfez, D. and Guillon, P., eds., 2nd Edition, Oxford, MS: Vector Fields, Inc., 1990, pp. 9-63.
- Hanson, D. F., *Microwave Resonators*, Chapter 2 of **Dielectric Resonators**, Kajfez, D. and Guillon, P., eds., Dedham, MA: Artech House, Inc., 1986.

PUBLICATIONS

- Hanson, Donald F., *A Survey of Recent Progress on pHEMT and HBT Power Transistors for Ka Band*, This is published on the COST 260 Web Site, <http://www.cost260.com> under the link <http://inet.uni2.dk/~pballing/cost260/trondhei/dhanson.pdf>. This and other papers are also published at <http://www.tele.ntnu.no/wirac/> in the WIRAC project archive, but these are password protected proprietary archival documents. COST stands for "COopération européenne dans le domaine de la recherche Scientifique et Technique", which is European cooperation in the field of scientific and technical research. COST 260 is cooperation or teaming in the area of Smart Antennas: Computer Aided Design & Technology. The WIRAC project is a multi-million dollar Norwegian project on WIdband Radio Access, Taastrup,

Denmark (COST 260, public) and Trondheim, Norway (WIRAC, proprietary): August 9, 1998, 40 pages.

- Donald F. Hanson (University of Mississippi), Jose Torres (VHDL), Chuck Swart (Analogy), and Alex Zamfirescu (Intergraph), *IEEE Standard VHDL Language Mathematical Packages (Math_Real and Math_Complex)*, **IEEE Std P1076.2-1995**, IEEE, New York, NY, 1996, 20 pages plus the software. Note: This VHDL Math Package was adopted from my original work by this committee and has been voted an official IEEE Standard P1076.2. I am one of the authors of this standard.
- Hanson, Donald F., *A VHDL Conversion Tool for Logic Equations with Embedded D Latches*, **Proceedings of the 1995 Workshop on Computer Architecture Education**, IEEE Computer Society, Technical Committee on Computer Architecture (TCCA) Newsletter, Spring 1995 issue, pp. 49-56.
- Hanson, Donald F., *An MHDL Model For Multi-Mode Rectangular Waveguide At A Physical Port*, **Proceedings of the 1995 International Conference on Electronic Hardware Description Languages (ICEHDL)**, eds. Wilsey and Rhodes, pp. 78-83, Jan. 15-18, 1995, Las Vegas, NV, The Society for Computer Simulation (SCS), San Diego, CA.
- Hanson, Donald F., *An MHDL Model for Dominant Mode Rectangular Waveguide*, **Proceedings of the International Conference on Simulation and Hardware Description Languages (ICSHDL)**, eds. Wilsey and Rhodes, The Society for Computer Simulation (SCS), San Diego, CA, Jan. 24-26, 1994, pp. 91-96.
- Hanson, Donald F., *Proposal for a Standard VHDL Mathematical Package*, **The Proceedings of the Fall 1992 VHDL International Users' Forum**, Oct. 18-21, 1992, Washington, DC, 11 pages, with Jose A. Torres (Synopsys, Inc.).

The following two publications, including a figure, were featured in the April 4, 1991 issue of **EDN** (News Edition) in a front page article written by Stephan Ohr:

- Hanson, Donald F., *Structural Level Simulation of Analog/Microwave Circuits in VHDL*, **Proceedings of the Spring 1991 VHDL Users' Group Conference**, April 1991, Cincinnati, OH, pp. 135-142.
- Hanson, Donald F., *Global Variables and Structural Level Subroutine Calls in VHDL*, **Proceedings of the Spring 1991 VHDL Users' Group Conference**, April 1991, Cincinnati, OH, pp. 189-196.
- Hanson, Donald F., **Public Release of VHDL version of Generic_Math_Routines, VHDL Libraries for the Real and Complex Elementary Functions**, U.S. Army, ETDL, Ft. Monmouth, NJ, March 12, 1991, Contract Number DAAL01-89-C-0927. I wrote a library of 32 special functions in VHDL.
- Hanson, Donald F., *A VHDL Model for Pass Transistors Used in the 6502 Microprocessor*, **Proceedings of the Fall 1989 VHDL Users' Group Meeting**, Redondo Beach, CA, October 22-25, 1989, pp. 12-19 to 12-25.
- Hanson, Donald F., *Electronic Scanners with Speech Output--A Communication System for the Physically Handicapped and Mentally Retarded*, **IEEE Micro**, Vol. 5, #2, April 1985, pp. 20-52 (with P.C. Power)
- Hanson, Donald F., *An Improved Model for a Microcomputer Component--The 6520 PIA*, **IEEE Micro**, Vol. 1, #4, November 1981, pp. 17-25
- Hanson, Donald F., *A Microprocessor Laboratory for Electrical Engineering Seniors*, **IEEE Trans. Education**, Vol. E-24, No. 1, February 1981, pp. 8-14

- Hanson, Donald F., *The Current Source-Function Technique Solution of Electromagnetic Scattering from a Half Plane*, (with P.E. Mayes), **Radio Science**, Vol. 13, No. 1, pp. 49-58, January-February 1978

Proceedings Publications

- Hanson, Donald F., *A Moment Method Solution for a Slot Antenna fed by Coplanar Waveguide*, **1987 Spring IEEE AP-S/URSI International Symposium Digest**, Vol. I, Virginia Tech., Blacksburg, VA, June 15-19, 1987, pp. 107-110.
- Hanson, Donald F., *Numerical Solutions of TM-Scattering from Generally-Directed and TE-Scattering from Radially-Directed Multiple Strips in the Presence of a Circular Conducting Cylinder*, **1987 Spring IEEE AP-S/URSI International Symposium Digest**, Vol. II, Virginia Tech., Blacksburg, VA, June 15-19, 1987, pp. 730-733 (with Man-Chun Yu and Chalmers M. Butler)
- Hanson, Donald F., *A Microprocessor Laboratory Course Based on an AIM-65 Solderless Interfacing Unit*, **Proc. 1981 Southeastern Section Ann. Meeting: Computers in Engineering and Technology Education**, University of Tennessee at Chattanooga, American Soc. for Eng. Education, April 1981, pp. 21-28.
- Hanson, Donald F., *Microcomputers in Electrical Engineering Education at the University of Mississippi*, **Proceedings of the Second Annual Symposium on Microprocessors and Education**, December 9, 1978, Huntsville, Alabama

Special Publications

- Hanson, Donald F., **Electronics Laboratory Manual**, Revised Edition, Department of Electrical Engineering, University of Mississippi, January 1996-99, 180 pages.
- Hanson, Donald F., **Electronics Laboratory Manual**, Department of Electrical Engineering, University of Mississippi, January 1995, 185 pages.
- Hanson, Donald F., **Electronics Laboratory Manual**, Department of Electrical Engineering, University of Mississippi, January 1990-1994, 185 pages.
- Hanson, Donald F., **Electronics Laboratory Manual**, Department of Electrical Engineering, University of Mississippi, January 1989, 185 pages.
- Hanson, Donald F., **Electronics Laboratory Experiments**, Department of Electrical Engineering, University of Mississippi, 1978, 13 Experiments.
- Hanson, Donald F., *Microwave Resonators*, Short Course Notes prepared for the *Dielectric Resonators Short Course*: March 18-20, 1985, Oxford, MS, 57 pages
- Hanson, Donald F., *Numerical Analysis Techniques in the Moment Method*, Short Course Notes prepared for the *Fundamentals of Numerical Solution Methods in Electromagnetics Short Course*; March 15-19, 1982 and October 15-18, 1984, Oxford, Mississippi, 77 pages.
- Hanson, Donald F., **Lighting and Wiring: Theory and Design**, class notes for Arch. 242, Department of Architecture, University of Illinois, Urbana, Illinois, 1974

SOFTWARE ARTIFACTS

- Hanson, Donald F., *Automatic Reference Handling System for INSPEC Database*, Software written for the purpose of automatic reference handling for the INSPEC database. This was needed to go through large numbers of papers in certain subject areas of interest to the Norwegians at NTNU's Department of Telecommunications, April 14, 1998.

- Donald F. Hanson (University of Mississippi), Jose Torres (VHDL), Chuck Swart (Analog), and Alex Zamfirescu (Intergraph), *IEEE Standard VHDL Language Mathematical Packages (Math_Real and Math_Complex)*, **IEEE Std P1076.2-1995**, IEEE, New York, NY, 1996. Note: This VHDL Math Package was adopted from my original work by this committee and has been voted an official IEEE Standard P1076.2. I am one of the authors of this standard. Approved 19 September 1996, 36 pages, comes with a floppy disk with the software.
- Hanson, Donald F., *Haskell module is named Waveguide_port*, **MHDL Working Group**, July 31, 1992. This artifact determines the propagating modes on a waveguide and orders the modes by cutoff frequency. It is written in the functional programming language Haskell.
- Hanson, Donald F., *Structural Level Simulation of Analog/Microwave Circuits in VHDL*, **Proceedings of the Spring 1991 VHDL Users' Group Conference**, April 1991, Cincinnati, OH, pp. 135-142. This artifact is a computer tool written in the event driven language VHDL-87 which solves an analog/microwave circuit by using transfer matrices.
- Hanson, Donald F., **A DSH to VHDL Translator for Logic Equations, Including D Latches, Written in C Using LEX and YACC with Application to VHDL Modeling of a 6502 Dynamic MOS Microprocessor**, 1989 U.S. Army Summer Faculty Research and Engineering Program Final Report, Contract No. DAAL03-86-D-0001, Delivery Order 1481, Scientific Services Program, Fort Monmouth, NJ, August 18, 1989, 118 pages. This report described the software artifact which was a translator between a Hardware Description Language that I invented called DSH and VHDL. This is also described in: Hanson, Donald F., *A VHDL Conversion Tool for Logic Equations with Embedded D Latches*, **Proceedings of the 1995 Workshop on Computer Architecture Education**, IEEE Computer Society, Technical Committee on Computer Architecture (TCCA) Newsletter, Spring 1995 issue, pp. 49-56, Raleigh, NC, January 22, 1995.
- Hanson, Donald F., **Public Release of VHDL version of Generic_Math_Routines, VHDL Libraries for the Real and Complex Elementary Functions**, U.S. Army, ETDL, Ft. Monmouth, NJ, March 12, 1991, Contract Number DAAL01-89-C-0927. I wrote a library of 32 special functions in VHDL. The IEEE Standard 1076.2 package header is based on this package header.

REPORTS

- Hanson, Donald F., **A Survey of Recent Progress on pHEMT and HBT Power Transistors for Ka Band**, WIRAC Report, Department of Telecommunications, NTNU, Trondheim, Norway, August 9, 1998, pp. 1-40. Also published on web: See under Journal Articles and Publications.
- Hanson, Donald F., **Active Devices and Power Combining Arrays for Wirac/Sarepta/Ka Band**, WIRAC Report, Department of Telecommunications, NTNU, Trondheim, Norway, August 9, 1998, pp. 1-8.
- Hanson, Donald F., **Automatic Reference Handling System for INSPEC Database**, WIRAC Report, Department of Telecommunications, NTNU, Trondheim, Norway, April 14, 1998, 11 pages.
- Hanson, Donald F., **Active Antennas and Power Combining Arrays for Wirac/Sarepta/Ka Band**, WIRAC Report, Department of Telecommunications, NTNU, Trondheim, Norway, March 10, 1998, 8 pages.

- Hanson, Donald F., **WIRAC RF/IF/Analog System Architecture and Antenna Partitioning**, WIRAC Report, Department of Telecommunications, NTNU, Trondheim, Norway, February 5, 1998, 11 pages.
- Hanson, Donald F., **Types of Antenna Arrays used in Papers from the 1997 Vehicular Technology Conference**, WIRAC Report, Department of Telecommunications, NTNU, Trondheim, Norway, Jan. 15, 1998, 17 pages.
- Hanson, Donald F., **Ka Band Technology and Smart Antennas**, WIRAC Report, Department of Telecommunications, NTNU, Trondheim, Norway, Sept. 18, 1997, 7 pages.
- Hanson, Donald F., Contributor to **Engineering Design Projects Compendium**, Charles M. Lovas and Paul F. Packman, eds., 3rd Edition, National Science Foundation, Workshop on ENHANCEMENT OF FACULTY DESIGN CAPABILITIES, Southern Methodist University, Dallas, TX, April 10, 1998. Also published at web site:
http://lyle.smu.edu/design_projects/electrical/electrical.html.

My contributions to this NSF publication are:

- Hanson, Donald F., Project FY-12, *Measurement Technology*, 4 pages, Aug. 10, 1995.
- Hanson, Donald F., Project FY-24, *Exerciser and Pulse Rate Monitor*, 4 pages, Aug. 10, 1995.
- Hanson, Donald F., Project FY-32, *Action Shadow*, 3 pages, Aug. 10, 1995.
- Hanson, Donald F., Project EL-04, *Digital Processor Design*, 3 pages, Aug. 10, 1995.
- Hanson, Donald F., Project EL-09, *Home Study Lighting*, 3 pages, Aug. 10, 1995.
- Hanson, Donald F., Project HT-06, *Temperature Control for Enclosed Electronics*, 3 pages, Aug. 10, 1995.
- Hanson, Donald F., **Multi-Mode Waveguide and Electromagnetics Models for MHDL**, FINAL REPORT, U. S. Army Research Office, Scientific Services Program, Contract No. DAAL03-91-C-0034, November 15, 1993, 80 pages.
- Hanson, Donald F., **Coplanar Waveguide Fed Slots**, Research Report Summer 1993, FINAL REPORT to Dean Smith, School of Engineering, University of Mississippi, July 30, 1993, 2 pages.
- Hanson, Donald F., *Connection Terminology*, **MHDL Working Group**, Jan. 22, 1993, 4 pages.
- Hanson, Donald F., *Series and Parallel Connections of Linear Transfer Functions/Matrices for Symbolic and Numerical Solution of Electrical Networks in MHDL*, **MHDL Working Group**, Aug. 11, 1992, 5 pages.
- Hanson, Donald F., *Concepts of Microwave Connections*, **MHDL Working Group**, Aug. 5, 1992, 7 pages.
- Hanson, Donald F., *Haskell module is named Waveguide_port*, **MHDL Working Group**, July 31, 1992, 12 pages.
- Hanson, Donald F., *Models for a Section of Uniform Lossless Multi-Mode Waveguide: Theory*, **MHDL WORKING GROUP**, July 16, 1992, 10 pages.
- Hanson, Donald F., *Attributes of Electrical Ports/Signals at Physical Ports in MHDL: Multi-Mode Waveguide*, **MHDL WORKING GROUP**, July 13, 1992, 6 pages.

- Hanson, Donald F., *Categorization of Wave-guiding Structures and Physical Ports for MHDL*, **MHDL WORKING GROUP**, June 23, 1992, 4 pages.
- Hanson, Donald F., *A Scenario for Extendable Interface Definitions and Connections*, **DARPA/TRI-SERVICE WORKSHOP on MIMIC Hardware Descriptive Language for Analog and Microwave Applications**, Orlando, FL, Feb. 5-6, 1992, 12 pages.
- Hanson, Donald F., **Public Release of VHDL version of Generic_Math_Routines, VHDL Libraries for the Real and Complex Elementary Functions**, U.S. Army, ETDL, Ft. Monmouth, NJ, March 12, 1991, Contract Number DAAL01-89-C-0927. I wrote a library of 32 special functions in VHDL. The IEEE Standard 1076.2 package header is based on this package header.
- **MHDL Requirements Document**, U.S. Army - LABCOM, Electronics Technology and Devices Laboratory, MIMIC Hardware Description Language (MHDL) Program, Fort Monmouth, NJ, August 15, 1991, 426 pages. Don Hanson was a member of an international team which developed the Requirements for the Design of MHDL and published the **MHDL Requirements Document**. He was the only full time University Professor working on this project. His areas of involvement were digital, analog, and microwave circuit requirements and the electromagnetic requirements. He was responsible for composing the glossary for the MHDL Requirements Document, Glossary, May 10, 1991.

In Appendix B of the **MHDL Requirements Document**, he wrote the following two white papers to support the MHDL project.

- Hanson, Donald F., *Quantitative Concepts About the Four Dimensions: Hierarchy, Abstraction, Alternatives, and Views*, **MHDL Requirements Document**, Appendix B, May 7, 1991, 6 pages.
- Hanson, Donald F., *Symbolic Computation in MHDL*, **MHDL Requirements Document**, Appendix B, May 23, 1991, 3 pages.
- Hanson, Donald F., *Generalized Transfer Functions in MHDL*, **MHDL WORKING GROUP**, May, 1991, 5 pages.
- Hanson, Donald F., **DSH, An Intuitive Language For Embedding Pass Transistor Structure Into Logic Equations, and Application to Reverse Engineering of Dynamic Two-Phase MOS Logic Circuits**, unpublished report.
- Hanson, Donald F., **A DSH to VHDL Translator for Logic Equations, Including D Latches, Written in C Using LEX and YACC with Application to VHDL Modeling of a 6502 Dynamic MOS Microprocessor**, 1989 U.S. Army Summer Faculty Research and Engineering Program Final Report, Contract No. DAAL03-86-D-0001, Delivery Order 1481, Scientific Services Program, Fort Monmouth, NJ, August 18, 1989, 118 pages.
- Hanson, Donald F., **Initial Developments on VHDL Modeling of a 6502 Dynamic MOS Microprocessor Using a DSH Recursion Equation to VHDL Translator Written in C with LEX and YACC**, 1988 U.S. Army Summer Faculty Research and Engineering Program Final Report, Contract No. DAAL03-86-D-0001, Delivery Order 0789, Scientific Services Program, Fort Monmouth, NJ, August 31, 1988, 144 pages.
- Hanson, Donald F., **Measurements of a Slot Antenna Fed by Coplanar Waveguide and Solution of an Infinite Phased Array of Slots Fed by Coplanar Waveguide Over a Dielectric Half-Space**, 1986 USAF-UES Mini-Grant Program Final Report, Contract No. F49620-85-C-0013, University of Mississippi, University, MS, June 1, 1988, 74 pages.

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- Hanson, Donald F., *A Study of Coplanar Waveguide and its Application to Phased Arrays of Integrated Circuit Antennas*, **1985 USAF-UES Summer Faculty Research Program Final Report**, Contract No. F49620-85-C-0013, RADC/EEA, Hanscom AFB, MA 01731, August 12, 1985
- Hanson, Donald F., **A CMOS Arrayed Parallel Processor Controlled by a 6502 Microprocessor Accelerating the Speed of Elementary Row and Column Operations in Performing Decompositions of Sparse Incidence Matrices of 2-Bit, Two's Complement Integers**, Final Report to NSF's Industrial Research Participation Program and to the General Electric Company, Syracuse, New York, August 1982
- Hanson, Donald F., **Electromagnetic Diffraction by a Narrow Slit in an Impedance Sheet--E-Polarization**, Final Report on Contract AFOSR-80-0172, Air Force Office of Scientific Research, Bolling AFB, DC, July 1981
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- Hanson, Donald F., **A Digital Integrated Circuit Tester**, Department of Electrical Engineering, University of Illinois, Urbana, Illinois, 1975
- Hanson, Donald F., **Outlining and Shading Generation for a Color Television Display**, Department of Computer Science, Urbana, Illinois, Atomic Energy Commission Report Number C00 1469-0204, June 1972.
- Hanson, Donald F., **Using CONVERT/TWS**, Translator Writing System Group Memorandum, ILLIAC IV Project, Department of Computer Science, University of Illinois, Urbana, Illinois, January 29, 1969.

PRESENTATIONS

- Hanson, D. F., *A Survey of Recent Progress on pHEMT and HBT Power Transistors for Ka Band*, **COST 260: Smart Antennas**, (international meeting), Trondheim, Norway, June 3-5, 1998.
- Hanson, D. F., *Smart Antennas and Microwave Technology in WIRAC*, WIRAC meeting (local), Department of Telecommunications, NTNU, Trondheim, Norway, Feb. 13, 1998.
- Hanson, Donald F., *A VHDL Conversion Tool for Logic Equations with Embedded D Latches*, **Proceedings of the 1995 Workshop on Computer Architecture Education**, IEEE Computer Society, Technical Committee on Computer Architecture (TCCA) Newsletter, Spring 1995 issue, pp. 49-56, Raleigh, NC, January 22, 1995.
- Hanson, Donald F., *An MHDL Model For Multi-Mode Rectangular Waveguide At A Physical Port*, **Proceedings of the 1995 International Conference on Electronic Hardware Description Languages (ICEHDL)**, eds. Wilsey and Rhodes, pp. 78-83, Jan. 15-18, 1995, Las Vegas, NV, The Society for Computer Simulation (SCS), San Diego, CA.
- Hanson, Donald F., *Current Problems with Phasors in MHDL*, **MHDL Working Group**, Las Vegas, NV, Jan. 13-14, 1995.

- Hanson, Donald F., *An MHDL Model for Dominant Mode Rectangular Waveguide*, **Proceedings of the International Conference on Simulation and Hardware Description Languages (ICSHDL)**, eds. Wilsey and Rhodes, The Society for Computer Simulation (SCS), San Diego, CA, Jan. 24-26, 1994, pp. 91-96.
- Hanson, Donald F., *Phasors in MHDL: A Start*, **MHDL Working Group**, Eatontown, NJ, Aug. 4-5, 1993.
- Hanson, Donald F., *Proposal for a Standard VHDL Mathematical Package*, **The Proceedings of the Fall 1992 VHDL International Users' Forum**, Oct. 18-21, 1992, Washington, DC, 11 pages, presented by Jose A. Torres (Synopsys, Inc.).
- Hanson, Donald F., *A Scenario for Extendable Interface Definitions and Connections*, **DARPA/TRI-SERVICE WORKSHOP on MIMIC Hardware Descriptive Language for Analog and Microwave Applications**, Orlando, FL, Feb. 5-6, 1992.
- Hanson, Donald F., *Structural Level Simulation of Analog/Microwave Circuits in VHDL*, **Proceedings of the Spring 1991 VHDL Users' Group Conference**, April 1991, Cincinnati, OH, pp. 135-142.
- Hanson, Donald F., *Global Variables and Structural Level Subroutine Calls in VHDL*, **Proceedings of the Spring 1991 VHDL Users' Group Conference**, April 1991, Cincinnati, OH, pp. 189-196.
- Hanson, Donald F., *Analog Simulation in VHDL*, **DARPA/TRI-SERVICE WORKSHOP on MIMIC Hardware Descriptive Language for Analog and Microwave Applications**, Eatontown, NJ, October 30-31, 1990.
- Hanson, Donald F., *Views on Incorporation of Microwave Circuits in a Hardware Description Language*, **DARPA/TRI-SERVICE WORKSHOP on Hardware Descriptive Language for Analog and Microwave Applications**, Ft. Monmouth, NJ, March 8, 1990.
- Hanson, Donald F., *A VHDL Model for Pass Transistors Used in the 6502 Microprocessor*, **Proceedings of the Fall 1989 VHDL Users' Group Meeting**, Redondo Beach, CA, October 22-25, 1989, pp. 12-19 to 12-25.
- Hanson, Donald F., *The Moment Method Applied to an Infinite Array of Slots Fed by Coplanar Waveguide*, **1988 Spring IEEE AP-S/URSI International Symposium Digest**, URSI Abstracts, Syracuse University, Syracuse, NY 13221, June 6-10, 1988, p. 380.
- Hanson, Donald F., *Design and Measurement of Printed Circuit Slot Antennas*, **Journal of the Mississippi Academy of Sciences**, Volume XXXIII, Supplement, p. 95. (with Anand Gundavajhala), February 24-26, 1988.
- Hanson, Donald F., *A Moment Method Solution for a Slot Antenna fed by Coplanar Waveguide*, **1987 Spring IEEE AP-S/URSI International Symposium Digest**, Vol. I, Virginia Tech. Blacksburg, VA, June 15-19, 1987, pp. 107-110.
- Hanson, Donald F., *Numerical Solutions of TM-Scattering from Generally-Directed and TE-Scattering from Radially-Directed Multiple Strips in the Presence of a Circular Conducting Cylinder*, **1987 Spring IEEE AP-S/URSI International Symposium Digest**, Vol. II, Virginia Tech Blacksburg, VA, June 15-19, 1987, pp. 730-733 (with Man-Chun Yu and Chalmers M. Butler)
- Hanson, Donald F., *Two-Dimensional Plane Wave Scattering from Multiple Radially-Directed Strips in the Presence of a Cylinder*, **1985 Spring IEEE AP-S/URSI International Symposium**, University of British Columbia, Vancouver, CANADA, Program Digest, June 20, 1985. (with Chalmers Butler)

- Hanson, Donald F., *Scattering by Strips and Arbitrarily-Shaped Cylinders (TM and TE Cases)*, presented at the *Fundamentals of Numerical Solution Methods in Electromagnetics* Short Course; October 15-18, 1984; Oxford, Mississippi
- Hanson, Donald F., *Numerical Aspects of Computation in the Moment Method*, presented at the *Fundamentals of Numerical Solution Methods in Electromagnetics* Short Course; October 15-18, 1984; Oxford, Mississippi
- Hanson, Donald F., *Two-Dimensional Plane Wave Scattering from Radially-Directed Strips in the Presence of a Cylinder*, a paper presented at the **1983 IEEE APS/URSI International Symposium**, National Radio Science Meeting Program and Abstracts Digest, p. 43, May 23-26, 1983, Houston, Texas (with Chalmers Butler)
- Hanson, Donald F., *Modeling of Two-Phase Logic*, **Journal of the Mississippi Academy of Science**, Vol. XXVIII, Supplement, February 25, 1983, p. 52
- Hanson, Donald F., *Numerical Analysis Techniques in the Moment Method*, A Presentation given at the *Fundamentals of Numerical Solution Methods in Electromagnetics* Short Course; March 15-19, 1982, Oxford, Mississippi
- Hanson, Donald F., *Electromagnetic Diffraction by a Narrow Slit in an Impedance Sheet--E-Polarization*, a paper presented at the **1981 IEEE APS/URSI International Symposium**, National Radio Science Meeting Program and Abstracts Digest, p. 28, June 1981, Los Angeles, California
- Hanson, Donald F., *A Microprocessor Laboratory Course Based on an AIM-65 Solderless Interfacing Unit*, **Proc. 1981 Southeastern Ann. Meeting: Computers in Engineering and Technology Education**, University of Tennessee at Chattanooga, American Soc. for Eng. Education, April 1981, pp. 21-28
- Hanson, Donald F., *Microcomputers in Electrical Engineering Education at the University of Mississippi*, a paper presented at the **Second Annual Symposium on Microprocessors and Education**, December 9, 1978, Huntsville, Alabama
- Hanson, Donald F., *Resident Assemblers/Editors and Cross-Assemblers for the 6502 Microprocessor*, a paper presented at the **NSF Chautauqua Short Course on Microprocessors**, March 3, 1978, Memphis, Tennessee
- Hanson, Donald F., *A Formulation for Electromagnetics Problems Using Direct Field Source Relations*, (with P.E. Mayes), **URSI Meeting Digest**, June 22-24, 1977, Stanford, California
- Hanson, Donald F., *Use of Hybrid Expansion in Moment Method to Incorporate Edge Conditions*, (with P.E. Mayes), **URSI Meeting Digest**, October 1975, Boulder, Colorado

FUNDED RESEARCH

- Hanson, Donald F., Invited Guest Professor, Dept. of Telecommunications, NTNU, Trondheim, Norway, WIRAC (WIdeband Radio ACcess) project team, funded by *Research Council of Norway* (Sabbatical Leave Project), Aug. 15, 1997 to Aug. 15, 1998, US\$32,500 (Half time) plus travel expenses.
- Hanson, Donald F., *Electronics CAD Software for SUN Workstation*, University of Mississippi Associates' Funds, Dec. 1996, \$7000.
- Donald F. Hanson and Robert Khayat, Advanced MicroElectronics Division of ITD-Jackson: Plotter for Integrated Circuit Design, (est. \$16,000 gift of plotter, February 28, 1996).

- Hanson, Donald F., University of Mississippi Associates' Funds: *High Performance SUN Workstation/Update to the Undergraduate Electrical Engineering Program in Digital System & Integrated Circuit Design*, (\$3,000, Dec. 1995).
- Hanson, Donald F., University of Mississippi Technology Enhancement Funds: *High Performance SUN Workstation*, (\$3,000, Dec. 1995).
- Hanson, Donald F., *Faculty Technology Development Application*, University of Mississippi: Sept. 15, 1995, \$400.
- Donald F. Hanson, NSF-SMU two-week short course: *Enhancement of Faculty Design Capabilities*, Southern Methodist University, Dallas, TX, (est. \$3,000, July 30 -August 11, 1995).
- Hanson, Donald F., *Faculty Technology Enhancement Program*, University of Mississippi, January 1995 - June 1995, \$1500.
- Hanson, Donald F., Consulting: U.S. Army Research Laboratory, Ft. Monmouth, NJ, *Multi-Mode Waveguide and Electromagnetics Models for MHD*, Scientific Services Program, Contract No. DAAL03-91-C-0034, June 1992-Aug. 1993.
- Hanson, Donald F., School of Engineering, University of Mississippi: *Coplanar Waveguide Fed Slots*, Research Funding, May 16, 1993 - June 1, 1993, \$2,808.
- Hanson, Donald F., U.S. Army Laboratory Command, Ft. Monmouth, NJ: *Object-Oriented and Semantic Models for Structural and Behavioral Specification of Microwave and Analog Circuits and Preliminary Development of a Hardware Description Language*, Sabbatical Leave Grant (June 1, 1990, \$65,591).
- Hanson, Donald F., University of Mississippi: *Supercomputer Research*, (\$1,000, May 15, 1989).
- Hanson, Donald F., University of Mississippi Associates' Funds: *Hardware Description Using VHDL*, (\$1000, October 7, 1988)
- Hanson, Donald F., Faculty Small Grants: *Techniques for Phased Array Antenna Modeling Using the Cyber 205 and Antenna Measurements*, University of Mississippi (\$1,500, March 8, 1988)
- Hanson, Donald F., Principal Investigator (Computational Electromagnetics Applied to Phased Array Antennas), Contract No. F49620-85-C-0013/SB5851-0360, Universal Energy Systems/AFOSR, Title - *An Infinite Phased Array of Slots Fed by Coplanar Waveguide Over a Dielectric Half-Space*, (\$20,000, 1987)
- Hanson, Donald F., University of Mississippi Foundation: Title--*CAD Microcomputer Laboratory Equipment* (\$24,484; 1985)
- Hanson, Donald F., Texas Instruments: Title-*Speech Synthesis Equipment* ((\$10,600; 1982) Hardware and Software)
- Hanson, Donald F., Principal Investigator (Applied Mathematics Research with Electromagnetic Applications), Contract Number AFOSR-80-0172, Air Force Office of Scientific Research: Title-*Electromagnetic Diffraction by a Narrow Slit in an Impedance Sheet* (\$10,000; 1979)
- Hanson, Donald F., Faculty Research Grant: University of Mississippi (\$1,237; 1978)

COURSE TAUGHT AT UNIVERSITY OF MINNESOTA (2005-2006)**Undergraduate course (Minnesota):**

EE 3601. Transmissions Lines, Fields, and Waves. Properties of transmission lines, electrostatics, magnetostatics, and electromagnetic waves in unbounded space, guides, cavities, and radiation theory, and antennas. Prerequisites: EE 2011. Math 2374.

COURSES TAUGHT AT THE UNIVERSITY OF MISSISSIPPI**Undergraduate Electrical Engineering Courses Taught (Mississippi):**

- El.E. 100 Introduction to Electrical Engineering. Relevant perspective on the entire electrical field with review of professional careers. (1).
- El.E. 335 Principles of Digital Systems, Binary numbers, number system conversion, coding schemes; Boolean algebra, axioms, theorems, Karnaugh map; logic design, Boolean functions, minimization; implementation of transform methods; asynchronous systems. Prerequisite: CSCI 251 or 111. Corequisite: 336. (3).
- El.E. 336 Digital Systems Laboratory I. Corequisite: 335 (3 lab hours) (1).
- El.E. 337 Digital Systems Laboratory II. Self-paced laboratory. Prerequisite: 335 and 336. (3 lab hours). (1).
- El.E. 341 Theory of Fields. Field concepts, vector algebra and calculus, Laplace's equations, wave equation, diffusion equation and their solutions; electric and magnetic fields, Maxwell's equations. Prerequisite: Math 264; Corequisite: Engr. 410. (3)
- El.E. 351,352 Models and Circuits I, II. Terminal characteristics of devices, graphical analysis, linear piece-wise analysis, two-port parameters, equivalent models and circuits. Prerequisite: Engr. 360. (3,3)
- El.E. 353 Electronics Laboratory. Corequisite: 352. (3 lab hours). (1)
- El.E. 357, 358 Electrical Engineering Problems I, II. Analytical procedures and numerical techniques in basic electrical engineering. Corequisite: 351, Engr. 361, 310. (3)
- El. E. 367, 368 Computer-Aided Design in Electrical Engineering I, II. Computer-Aided Design (CAD) and analytical procedures in electrical engineering. Corequisite: 351, ENGR 361, 310. (1,1)
- El. E. 385 Advanced Digital Systems. Organization and design of digital computing systems. Register transfer language and hardware aspects of computing systems. Corequisite: 335, 336. (2).
- El.E. 433 High Frequency and Microwave Laboratory. Prerequisite: 333, 441 (3 lab hours) (1)
- El.E. 435 Advanced Digital Systems. Design and application of digital integrated circuits. Design and implementation of simple electronic computing elements. Hardware principles of microprocessor interfacing. Prerequisite: 335, 336, 351, and 352.
- El.E. 436 Advanced Digital Systems Laboratory. Design and application of digital integrated circuits. Digital system realization with digital integrated circuits. Programming and interfacing microprocessors and electronic systems. Corequisite: 435. (3 lab hours) (1)
- El.E. 486 Microprocessor Systems Engineering Laboratory. Design and application of digital integrated circuits. Digital system realization. Programming and interfacing microprocessors and electronic systems. Corequisite: 485. (3 lab hours). (1).

- El.E. 441, 442 Electromagnetic Theory I, II. Transmission-line theory, electric and magnetic properties of matter, plane waves, guided waves; wave propagation in anisotropic media, microwave networks, radiation, antennas. Prerequisite: 341. (3,3)
- El E 447 Modulation, Noise and Communications. Random functions, spectral analysis, correlation, modulation techniques, information, communication systems, and noise. Prerequisite: El E 331, 352. (3).
- El.E. 453 Solid State Devices. Crystals, conduction, semiconductors, dielectric and magnetic materials, energy band theory applied to junction devices, transistors. (same as PHYS 453)
- El.E. 461, 462 Senior Design I, II. Prerequisite: senior status. (3 and 6 lab hours respectively) (1,2)
- El. E. 523 Microwave Engineering. Microwave integrated circuits, scattering matrix description of microwave circuit elements, computer analysis of cascaded two-ports, microwave semiconductor devices. Prerequisite: EL E 441. (3)
- El E 525 Introduction to Antennas. Linear antennas and use of computer programs for antenna analysis and design. Arrays of antennas, beam shaping methods, and mathematical techniques. Prerequisite: El E 441. (3)

Undergraduate College of Engineering Courses Taught (Mississippi):

- Engr. 360 Electric Circuit Theory. Fundamental circuit concepts and laws, network analysis and theorems, forced and transient response, steady-state response, coupled circuits, two-port networks. Prerequisite: PHYS 212; Corequisite: MATH 353. (4)
- Engr. 361 Electric Circuit Laboratory. Circuit elements and instruments; experiments dealing with series and two-port networks, voltage, current, power, vars. Prerequisite: 360. (1)

Graduate-Level Engineering Courses Taught (Mississippi):

- El. E. 523 Microwave Engineering. Microwave integrated circuits, scattering matrix description of microwave circuit elements, computer analysis of cascaded two-ports, microwave semiconductor devices. Prerequisite: EL E 441. (3)
- El E 525 Introduction to Antennas. Linear antennas and use of computer programs for antenna analysis and design. Arrays of antennas, beam shaping methods, and mathematical techniques. Prerequisite: El E 441. (3)
- Engr. 597 Special Projects. Approved investigation of original problem under direction of a staff member. (May be repeated for credit). (2). (Title: Supercomputing for Engineers)
- Engr. 621 Advanced Electrodynamics. Boundary-value problems. Green's functions, general transmission systems, coupled transmission systems, microwave optics, scattering. Prerequisite: El.E. 441. (3)
- Engr. 622 Advanced Electromagnetic Theory. Lectures on recent developments in electromagnetic theory. Topic--Dielectric Resonators. Prerequisite: 621. (3).
- Engr. 623 Passive Microwave Circuits. Guided electromagnetic waves, linear multiports, computer analysis and optimization of microwave circuits, multiconductor transmission lines, filters. Prerequisite: El.E. 442. (3)
- Engr. 628 Numerical Methods In Electromagnetics. Integral equation formulation for static and dynamic electromagnetic fields, method of moments solution techniques subdomain and

entire-domain basis sets, testing procedures, Galerkin's Method, radiation and scattering.
Prerequisite: 621. (3)

Engr. 687 Special Functions for Applications. Polynomials, basic special functions, series and integral solutions of differential equations, asymptotic methods, properties of major special functions, applications. (3).

Engr. 691 Special Topics in Engineering Science: Computer Aided Design in Microwave Circuits.

Engr. 695 Seminar. Presentation of papers by faculty, visiting lecturers and graduate students.
Prerequisite: consent of instructor. (May be repeated for credit). (1)

Engr. 729 Special Topics in Electromagnetic Theory. (May be repeated for credit). (1) (Title: Computer Evaluation of Special Functions for Electromagnetics)

COURSES TAUGHT AT SYRACUSE UNIVERSITY (1983-84)

Undergraduate course (Syracuse):

ECE 431 Analog Circuits and Systems. Amplifiers using bipolar and field-effect transistors. Low- and high-frequency small-signal models. Multistage amplifiers, stabilization and noise considerations. Prerequisite: ECE 351.

Graduate course (Syracuse):

ECE 735 Digital Circuit Design. Digital electronics design using discrete and integrated circuits elements. Comparison of power, speed, density, noise immunity. Interfacing. Circuits involved in D/A and A/D converters. Use of charge-coupled devices in shift registers and image sensors. Prerequisite: ECE 633 or equivalent.

COURSES TAUGHT AT IOWA STATE UNIVERSITY (1976-1977)

Undergraduate courses (Iowa State):

E.E. 205, 206 Electric Circuits I, II. Prerequisite, 200 credit or classifications in Math 223 or 233 and Physics 223,. Circuit elements and models. Controlled sources. Kirchoff's laws. Model and loop analysis. network simplification techniques. Power and energy. RC, RL, and RLC transients. Circuits with operational amplifiers. Sinusoidal steady-state. Three-phase circuits. Simple resonant circuits. Mutual inductance.

E.E. 213 Introduction to Electromagnetic Fields I. Prerequisite: Phys 223, credit or classification in Math 321. Vector analysis, principles of electromagnetic fields, energy and potential, capacitance, introduction to magnetostatics, magnetic circuits, inductance.

E.E. 374, 375, 376 Electronics Engineering. Prerequisite: 374, 208, 231, 375, 374.
Introduction to transistor physical electronics. Linear, piecewise-linear and large-signal modeling of selected electronic devices. Analysis and design of electronic circuits. Biasing, amplification, distortion, power relations, diode applications.. The diode and active devices in switching applications. Analysis and design of pulse and digital circuits such as linear sweeps, multivibrators, logic elements. Negative resistance devices. The department recommends that credit in both the 374, 375, 376, and the 445, 446 sequences not be applied toward graduation.

REVIEWER

- IEEE Micro
- IEEE Transactions on Antennas and Propagation
- IEEE Transactions on Education
- Harper and Row, Inc.
- Journal of Electromagnetic Waves and Applications
- Addison-Wesley, Inc., reviewer for VHDL oriented textbooks, including Cypress Semiconductor, VHDL Synthesis for Programmable Logic.

Keywords: 3D, ABB, Adaptive, aecXML, AGI lighting software, Heating, Refrigerating, Air-Conditioning, analog, Analysis, ANSI, ASHRAE, autocad, AutoCAD, AEX, BACnet, BAS, BCS, BEMS, BIM, BiQ, BT, Building Automation and Control Networks, Building Information Modeling, Building Intelligence Quotient, Building Science Research, C/C++, CABA, CAD, CADD, CE Pro, CEA, CEDIA, compiler, Construction, Consumer Electronics Association, Continental Automated Building Association, Control System Modeling Language, CSML, Control4, Convia, Cost, CRESTRON, DALI, DDC, DDE, Dealerscope, Design, digital, DOD, DOE, Drawings, Echelon, ECO-Experience, EERE, EIS, EMCS, EMS, Energy, FCC, finite element, FlashPoint Technologies, GE, GEMnet, GHz, Green Building XML Schema, gbXML, Hazard, Hierachical, Honeywell, HVAC, IAI Industry Foundation Classes, IFC, IBECS, IEA, IEC, IEC 61131, IEEE, IFC, IL-Illinois, IMDS, ISO, ISO/IEC 14908, IT, LAN, LBNL, LEED, lex, LON, LONMARK, LonTalk Protocol, Matlab/Simulink, MHz, Microcontroller, MN-Minnesota, Modelica, NABCEP, National Society of Professional Engineers, NIST, Product Data Standards for HVAC/R Systems, NREL, NSPE, OASIS Open Building Information Exchange Technical Committee, oBIX, OLE for Process Control, OPC, Phase, PID control, PIER, PLC, PLC and HMI programming, Policy Analysis, POWER SYSTEMS, Preconstruction, Pro-E, PV, R&D, Renewable Energy, RFI, Schedule, SKM Integrated Study Software, SKM Power, Solar Energy, Solidworks, SPARK, Specifications, SSL, STB, System Dynamics, TRANE, TRIZ, UPS, VCBT, Visio, WAP, WBD, XML web services, yacc, ZIGBEE