Alan V. Sahakian, August 2023

CURRENTLY, AT NORTHWESTERN UNIVERSITY:

Professor of Electrical and Computer Engineering and Professor (by courtesy) of Biomedical Engineering
Associate Dean, Robert R. McCormick School of Engineering and Applied Science
Academic Affiliate Staff, Department of Cardiology, NorthShore University HealthSystem (Evanston Hospital)

EDUCATION:

5/1984 **Ph.D.** in Electrical and Computer Engineering with a minor in Computer Science from the University of Wisconsin-Madison. Thesis title: "*Algorithm, Architecture and Electrode Studies for Apnea Monitoring using a Multi-Microprocessor System*." Major advisor: Willis J. Tompkins (ECE), Minor Advisor: Edward F. Moore (CS)
8/1979 **MSEE** from the University of Wisconsin-Madison. Thesis title: "*A Microprocessor-Based Arrhythmia Monitor/Recorder for the Operating and Recovery Rooms*"
5/1976 **BS** in Applied Science and Physics from the University of Wisconsin- Parkside. Also studied Electrical and Computer Engineering at UW-Madison.

EXPERIENCE:

2000-present:

Professor of Electrical Engineering and Computer Science (became Electrical and Computer Engineering in September 2018) and of Biomedical Engineering (by courtesy while serving as the chair of EECS), Northwestern University

Senior Advisor to the Dean of the Robert R. McCormick School of Engineering and Applied Science. Responsible for Centers, International Relations, Program Review and Faculty Awards and Honors, and COVID management (January 2019-present)

Chair of the Electrical Engineering and Computer Science Department (July 1, 2011 – December 31, 2018)

John A. Dever Professor of Electrical Engineering and Computer Science (September 2015 – December 2018)

Associate Chair of EECS/ECE Department for Undergraduate Program (2003-July 2011).

Director of EECS Signals and Systems Division (2005-2019).

Charles Deering McCormick Chaired Professor of Teaching Excellence (1999-2002)

1990-2000:

Associate Professor of Electrical Engineering and Computer Science (Electrical and Computer Engineering) and of Biomedical Engineering

Bette and Neisen Harris Chaired Professor of Teaching Excellence (9/93-8/95)

Director of ECE Instructional Labs (9/98-8/00)

Associate Chair for ECE Undergraduate Program and Accreditation (9/93-8/98).

1984-1990: **Assistant Professor** of Electrical Engineering and Computer Science, Northwestern University, with courtesy appointment in Biomedical Engineering.
1985-present: **Member: Academic Affiliate Staff** (formerly Associate Professional Staff) Department of Medicine, Evanston Hospital (NorthShore University HealthSystem). Research, primarily into cardiac electrophysiology.
Summer 1987: **Resident Visiting Scholar**, Center for Excellence in Reliability and Maintainability, Air Force Institute of Technology, Wright Patterson Air Force Base, Dayton, OH. Studied reliability science, particularly high-reliability systems and fault-tolerant computing.
1980-84 and 1978 - 79: **Research Assistant**, Electrical and Computer Engineering Department, University of Wisconsin-Madison. Studied Electrical and Computer Engineering and Computer Science. Researched algorithms, architectures and instrumentation methods for medical patient monitoring including neonatal apnea (SIDS) and cardiac arrhythmias in ambulatory and surgical situations. Developed novel adaptive signal processing methods for signal separation.
1982-1983: **Electrical Engineer**, Applied Electronic Consultants Inc. and sister corporation Bahr Technologies, Madison, WI. Developed computer hardware, algorithms, and system software for medical patient monitoring.
1979-1980: **Senior Electrical Engineer, Microprocessor Design Specialist**, Medtronic Inc., Minneapolis, MN. Responsible for developing computer architectures, devices, and algorithms for patient-worn and implantable heart monitors. Developed novel low-power digital and mixed-signal circuits and systems.

RESEARCH INTERESTS:

My lab has several recent research interests (with funding from the sources listed):

1) The electrophysiology of the atrial cardiac arrhythmias, in particular atrial fibrillation, and algorithms and devices for arrhythmia monitoring and management (Medtronic, Dr. Scholl Foundation, Northwestern Memorial Foundation Dixon Research Grants).
2) Microwave and millimeter-wave systems and related signal processing for non-contact patient monitoring and imaging/therapy (DoD Breast Cancer CDMRP, DIA through DoE)
3) Impedance measurement and imaging on biological tissues (NIH NINDS)
4) Image-guided irreversible electroporation ablation therapy for non-resectable cancerous tumors of the liver, pancreas, and other organs (NIH NCI)
5) RF ablation to create a cancer-free margin in post-lumpectomy breasts (NSF)
6) Novel logic realizations including spintronic and other beyond-CMOS approaches (Intel)

PUBLICATIONS AND PATENTS:

https://orcid.org/0000-0003-3090-0328

JOURNAL PAPERS:

1) Emin A. Oral and Alan V. Sahakian, "Breast Tumor Detection and Classification Based on Microwave Imaging," Erzincan Journal of Science and Technology, Volume 15, Issue 2, pp. 622-635, https://doi.org/10.18185/erzifbed.1130305 ,August 2022.
2) Yeon Sik Choi, Hyoyoung Jeong, Rose T Yin, Raudel Avila, Anna Pfenniger, Jaeyoung Yoo, Jong Yoon Lee, Andreas Tzavelis, Young Joong Lee, Sheena W Chen, Helen S Knight, Seungyeob Kim, Hak-Young Ahn, Grace Wickerson, Abraham Vázquez-Guardado, Elizabeth Higbee-Dempsey, Bender A Russo, Michael A Napolitano, Timothy J Holleran, Leen Abdul Razzak, Alana N Miniovich, Geumbee Lee, Beth Geist, Brandon Kim, Shuling Han, Jaclyn A Brennan, Kedar Aras, Sung Soo Kwak, Joohee Kim, Emily Alexandria Waters, Xiangxing Yang, Amy Burrell, Keum San Chun, Claire Liu, Changsheng Wu, Alina Y Rwei, Alisha N Spann, Anthony Banks, David Johnson, Zheng Jenny Zhang, Chad R Haney, Sung Hun Jin, Alan Varteres Sahakian, Yonggang Huang, Gregory D Trachiotis, Bradley P Knight, Rishi K Arora, Igor R Efimov, John A Rogers, "A Transient, Closed-Loop Network of Wireless, Body-Integrated Devices for Autonomous Electrotherapy, Science, 376(6596), pp. 1006-1012, May 27, 2022.
3) Yeon Sik Choi, Rose T. Yin, Anna Pfenniger, Jahyun Koo, Raudel Avila, K. Benjamin Lee, Sheena W. Chen, Geumbee Lee, Gang Li, Yun Qiao, Alejandro Murillo-Berlioz, Alexi Kiss, Shuling Han, Seung Min Lee, Chenhang, Zhaoqian Xie, Yu-Yu Chen, Amy Burrell, Beth Geist, Hyoyoung Jeong, Joohee Kim, Hong-Joon Yoon, Anthony Banks, Seung-Kyun Kang, Zheng Jenny Zhang, Chad R. Haney, Alan Varteres Sahakian, David Johnson, Tatiana Efimova, Yonggang Huang, Gregory D. Trachiotis, Bradley P. Knight, Rishi K. Arora, Igor R. Efimov and John A. Rogers, "Fully implantable and bioresorbable cardiac pacemakers without leads or batteries," Nature Biotechnology, https://doi.org/10.1038/s41587-021-00948-x, June, 2021.
4) Emre Besler, Priyanka K. Mathur, Hawkins C. Gay, Rod S. Passman, and Alan V. Sahakian, "Inter-Patient Atrial Flutter Classification Using FFT-Based Features and a Low-Variance Stacking Classifier," IEEE Transactions on Biomedical Engineering, (Early Access online, June, 2021).
5) E. Besler; Y.C. Wang and A.V. Sahakian, "Early and Late Fusion Machine Learning on Multi-Frequency Electrical Impedance Data to Improve Radiofrequency Ablation Monitoring," IEEE Journal of Biomedical and Health Informatics, V24(8) pp. 2359-2367, **DOI:** 10.1109/JBHI.2019.2952922 ,November, 2019.
6) E. Besler, Y.C. Wang and A.V. Sahakian, "Real-time Radiofrequency Ablation Lesion Depth Estimation Using Multi-frequency Impedance with a Deep Neural Network and Tree-based Ensembles," IEEE Transactions on Biomedical Engineering, DOI 10.1109/TBME.2019.2950342, IEEE, October 2019.
7) Y. Schwarz, J. Wasserlauf, A.V. Sahakian and B. Knight, "Inappropriate activation of pacemaker magnet response mode by CPAP masks," Pacing and Clinical Electrophysiology, 10 April 2019 https://doi.org/10.1111/pace.13693.

8) E. Besler, Y.C. Wang, T. Chan and A.V. Sahakian, "Real-time Monitoring of Radiofrequency Ablation Using Tree-based Ensemble Learning Models," International Journal of Hyperthermia, V36(1) pp. 428-437, April 2019.
9) F. Callawaert, V. Velev, P. Kumar, A.V. Sahakian and K. Aydin "Inverse-Designed Streetchable Metalens with Tunable Focal Distance," Applied Physics Letters, 112, 091102 (2018), https://doi.org/10.1063/1.5017719 , Feb 2018.
10) F. Callewaert, V. Velev, P. Kumar, A.V. Sahakian and K. Aydin "Inverse-Designed Broadband All-Dielectric Electromagnetic Metadevices," Scientific Reports, https://www.nature.com/articles/s41598-018-19796-y Jan. 22, 2018.
11) Y.C. Wang, T.C. Chan and A.V. Sahakian, "Real-time estimation of lesion depth and control of radiofrequency ablation within ex vivo animal tissues using a neural network," International Journal of Hyperthermia, https://doi.org/10.1038/s41598-018-19796-y, 10.1080/02656736.2017.1416495, Jan. 4, 2018.
12) J.S. Friedman, A.J. Girdhar, R.M. Gelfand, G. Memik, H. Mohseni, A. Taflove, B.W. Wessels, J-P. Leburton and A.V. Sahakian, "Cascaded Spintronic Logic with Low-Dimensional Carbon," Nature Communications, Article number 15635 (2017), doi:10.1038/ncomms15635, http://www.nature.com/articles/ncomms15635, June 5, 2017.
13) J.S. Friedman, A. Godkin, A. Henning, Y. Vaknin, Y. Rosenwaks and A.V. Sahakian, "Threshold Logic with Electrostatically Formed Nanowires," IEEE Transactions on Electron Devices, V63(3), pp. 1388-1391, March 2016.
14) J.S. Friedman, E.R. Fadel, B.W. Wessels, D. Querlioz and A.V. Sahakian, "Bilayer Avalanche Spin-Diode Logic," AIP Advances 5, 117102, http://scitation.aip.org/content/aip/journal/adva/5/11/10.1063/1.4935262 , October 2015.
15) J.S. Friedman, B.W. Wessels, G. Memik and A.V. Sahakian, "Emitter-Coupled Spin-Transistor Logic: Cascaded Spintronic Computing Beyond 10 GHz," IEEE Journal on Emerging and Selected Topics in Circuits and Systems, Vol 5(1), pp. 17-27, http://dx.doi.org/10.1109/JETCAS.2015.2398231, February, 2015..
16) J.S. Friedman and A.V. Sahakian, "Complementary Magnetic Tunnel Junction Logic," IEEE Transactions on Electron Devices, Vol.16(4), pp. 1207-1210, April 2014..
17) J.S. Friedman, J.A. Peters, G. Memik, B.W. Wessels and A.V. Sahakian, "Emitter-Coupled Spin-Transistor Logic," Journal of Parallel and Distributed Computing, http://dx.doi.org/10.1016/j.jpdc.2013.08.012 , 2013.
18) I.V. Mikhelson, P.G. Lee, A.V. Sahakian and A.K. Katsaggelos, "Automatic, Fast, Online Calibration Between Depth and Color Cameras," Journal of Visual Communication and Image Representation, 2013.
19) I.V. Mikhelson, S. Bakhtiari, T.W. Elmer and A.V. Sahakian, "Remote Sensing of Patterns of Cardiac Activity on an Ambulatory Subject Using Millimeter-Wave Interferometry and Statistical Methods," Medical and Biological Engineering and Computing, Vol 51(1-2), pp.135-142, DOI: 10.1007/s11517-012-0977-6, February 2013.
20) I.V. Mikhelson, P. Lee, S. Bakhtiari, T.W. Elmer, A.K. Katsaggelos and A.V. Sahakian, "Non-Contact Millimeter-Wave Real-Time Detection and Tracking of Heart Rate on an Ambulatory Subject," IEEE Transactions on Information Technology in Biomedicine, Vol. 16(5), pp. 927-934, September 2012.
21) O.O. Adeyanju, H.M. Al-Angari and A.V. Sahakian, "The Optimization of Needle Electrode Number and Placement for Irreversible Electroporation of Hepatocellular Carcinoma," Radiology and Oncology, Vol. 46(2), pp. 126-135, April 2012.

22) A.V. Sahakian, H. M. Al-Angari, and O.O. Adeyanju, "Electrode Activation Sequencing Employing Conductivity Changes in Irreversible Electroporation Tissue Ablation," IEEE Transactions on Biomedical Engineering, Vol. 59(3), pp. 604-607, March 2012.
23) H. al-Angari and A.V. Sahakian, "Automated Recognition of Obstructive Sleep Apnea Syndrome Using Support Vector Machine Classifier," IEEE Transactions on Information Technology in Biomedicine, Vol. 16(3), pp. 463-468, May 2012.
24) S. Bakhtiari, T.W. Elmer, N.M. Cox, N. Gopalsami, A.C. Raptis, S. Lin, I.V. Mikhelson and A.V. Sahakian, "Compact Millimeter Wave Sensor for Remote Monitoring of Vital Signs," IEEE Transactions on Instrumentation and Measurement, Vol.61(3), pp. 830-841, March 2012.
25) O.O. Adeyanju, H. al-Angari and A.V. Sahakian, "The Improvement of Irreversible Electroporation Therapy Using Saline-Irrigated Electrodes: a Theoretical Study," Technol Cancer Res Treat., Vol.10(4), pp. 347-60, August 2011.
26) I.V. Mikhelson, S. Bakhtiari, T.W. Elmer and A.V. Sahakian, "Remote Sensing of Heart Rate and Patterns of Respiration on a Stationary Subject Using 94 GHz Millimeter Wave Interferometry," IEEE Transactions on Biomedical Engineering, Vol. 58, Issue 6, pp. 1671-1677, June 2011.
27) J. Koenig, A.V. Sahakian, A. Ricke, and S. Swiryn, "Observations of Pacemaker Pulses in High Bandwidth Electrocardiograms and Dower-estimated Vectorcardiograms," Journal of Electrocardiology, Vol. 44, pp. 275-281, 2011.
28) Y. Guo, Y. Zhang, G.M. Nijm, A.V. Sahakian, G.-Yu Yang, R.A. Omary, and A.C. Larson," Irreversible Electroporation in the Liver: Contrast-enhanced Inversion-Recovery MR Imaging Approaches to Differentiate Reversibly Electroporated Penumbra from Irreversibly Electroporated Ablation Zones," Radiology, Vol. 258, pp. 461-468, Feb. 2011.
29) Y. Zhang, Y. Guio, A.B. Ragin, R.J. Lewandowski, G.-Y. Yang, G.M. Nijm, A.V. Sahakian, R. Omary and A.C.Larson, "MR Imaging to Assess Immediate Response to Irreversible Electroporation for Targeted Ablation of Liver Tissues: Preclinical Feasibility Studies in a Rodent Model," Radiology 256(2), pp. 424-432, 2010.
30) A. Mashal, B. Sitharaman, X. Li, P.K. Avti, A.V. Sahakian, J.H. Booske, and S.C. Hagness, "Toward Carbon-Nanotube-Based Theranostic Agents for Microwave Detection and Treatment of Breast Cancer: Enhanced Dielectric and Heating Response of Tissue-Mimicking Materials," IEEE Transactions on Biomedical Engineering, 57(8), pp. 1831-1834, 2010.
31) Y. Guo, Y. Zhang, R. Klein, G.M. Nijm, A.V. Sahakian, R.A. Omary, G.-Yu Yang, and A.C. Larson, "Irreversible Electroporation Therapy in the Liver: Longitudinal Efficacy Studies in a Rat Model of Hepatocellular Carcinoma," Cancer Research, 70(4), pp. 1555-1563, 2010.
32) A.Heifitz, S-C Kong, A.V. Sahakian, A. Taflove, V. Backman, "Photonic Nanojets," Journal of computational and Theoretical Nanoscience, 6(9), pp. 1979-1992, 2009.
33) S. Petrutiu, A.V. Sahakian, W. Fisher and S. Swiryn, "Manifestation of Left Atrial Events and Inter-atrial Frequency Gradients in the Surface Electrocardiogram during Atrial Fibrillation: Contributions from Posterior Leads," Journal of Cardiovascular Electrophysiology, 2009.
34) A.D. Ricke, S. Swiryn, A.V. Sahakian, S. Petrutiu, B. Young, and G.I. Rowlandson, " The relationship Between Programmed Pacemaker Pulse Amplitude and Surface ECG recorded

Amplitude: Application of a New High Resolution ECG System," Journal of Electrocardiology, Vol. 41(6), pp. 526-530, November 2008

35) G.M. Nijm, A.V. Sahakian, S. Swiryn, J.C. Carr, J.J. Sheehan and A.C. Larson, "Comparison of Self-Gated Cine MRI Retrospective Cardiac Synchronization Algorithms," Journal of Magnetic Resonance Imaging, 28(3), pp. 767-772, 2008.
36) S-C Kong, A.V. Sahakian, A. Taflove, V. Backman, "High-density Optical Data Storage Enabled by the Photonic Nanojet from a Dielectric Microsphere, Japanese Journal of Applied Physics, 48(3), 2009.
37) G.M. Nijm, S. Swiryn, A.C. Larson and A.V. Sahakian, "Extraction of the Magnetohydrodynamic Blood Flow Potential from the Surface Electrocardiogram in Magnetic Resonance Imaging," Medical and Biological Engineering and Computing, 46(7), pp. 729-733, 2008.
38) S-C Kong, A.V. Sahakian, A. Taflove and V. Backman, "Photonic nanojet-enabled optical data storage," Optics Express, Vol. 16, Issue 18, pp. 13713-13719, 2008
39) S-C Kong, A.V. Sahakian, A. Heifetz, A. Taflove and V. Backman, "Robust Detection of Deeply Subwavelength Pits in Simulated Optical Data-Storage Disks Using Photonic Jets," Applied Physics Letters 92(21), pp. 211102-211102-3, 2008 (Cover article).
40) E C Ehman, P J Rossman, S A Kruse, A V Sahakian and K J Glaser, "Vibration safety limits for magnetic resonance elastography," Physics in Medicine and Biology, 53, pp. 925-935, 2008.
41) M.S. Guillem, A.V. Sahakian and S. Swiryn, "Derivation of Orthogonal Leads from the 12-Lead ECG. Performance of an atrial-based transform for the derivation of P loops," Journal of Electrocardiology 41(1) pp. 19-25, 2008.
42) H. al-Angari and A.V. Sahakian, "Use of Sample Entropy Approach to Study Heart Rate Variability in Obstructive Sleep Apnea Syndrome," IEEE Transactions on Biomedical Engineering, 54(10) pp. 1900-1904, 2007.
43) S. Petrutiu, A.V. Sahakian and S. Swiryn, "Abrupt changes in fibrillatory wave characteristics at the termination of paroxysmal atrial fibrillation in humans," Europace, 9(7), pp. 466-470, 2007.
44) M. Ruffolo, M.S. Daskin, A.V. Sahakian and R. Berry, "Design of a Large Network for Radiological Image Data," IEEE Transactions on Information Technology in Biomedicine, 11(1) pp. 25-39, 2007.
45) S. Petrutiu, A.V. Sahakian and S. Swiryn, "Short-Term Dynamics in Fibrillatory Wave Characteristics at the Onset of Paroxysmal Atrial Fibrillation in Humans," The Journal of Electrocardiology, 40(2) pp. 155-160, 2007.
46) A.Heifetz, K. Huang, A.V. Sahakian, X. Li, A. Taflove and V. Backman, "Experimental Confirmation of Backscattering Enhancement Induced by a Photonic Jet," Applied Physics Letters, 89(22), pp. 221118-221118-3, 2006.
47) S. Petrutiu, J. Ng, G. M. Nijm, H. al-Angari, S. Swiryn and A.V. Sahakian, "Atrial fibrillation and waveform characterization in the surface ECG – a time domain perpective," (Invited Paper), IEEE EMBS Magazine, 25(6) pp. 24-30, Nov.2006.
48) Q. Xi, A.V. Sahakian, T.G. Frohlich, J. Ng, S.Swiryn, "Relationship between the pattern of occurrence of atrial fibrillation and surface ECG fibrillatory wave characteristics," Heart Rhythm, 1(6), pp. 656-663, 2004.

49) J. Ng, A.V. Sahakian, W.G. Fisher and S. Swiryn, "Surface ECG vector characteristics of organized and disorganized atrial activity during atrial fibrillation," Journal of Electrocardiology, 37(supplement), pp. 91-97, 2004.
50) Q. Xi, A.V. Sahakian, J. Ng, and S. Swiryn, "Atrial fibrillatory wave characteristics in the surface electrocardiogram: consistency over twenty-four hours in clinically stable patients," Journal of Cardiovascular Electrophysiology, 15(8), pp. 911-917, August 2004.
51) J. Ng, A.V. Sahakian, W.G. Fisher and S. Swiryn, "Atrial Flutter Loops Derived from the Surface ECG: Does the Plane of the Loop Correspond Anatomically to the Macro-reentrant Circuit," The Journal of Electrocardiology, 36, supplement 1, pp. 181-186, 2003.
52) J. Ng, A.V. Sahakian and S. Swiryn, "Accelerometer-Based Body-Position Sensing for Ambulatory Electrocardiographic Monitoring," Biomedical Instrumentation and Technology, 37(5), pp. 338-346, 2003.
53) Q. Xi, A.V. Sahakian and S. Swiryn, "The effect of QRS cancellation on atrial fibrillatory wave signal characteristics in the surface electrocardiogram,": The Journal of Electrocardiology, 36(3), pp. 243-249, 2003.
54) A.V. Sahakian, M.-S. Lee-Peterson, S. Shkurovich, M. Hamer, T. Votapka, T. Ji and S. Swiryn, "A simultaneous multichannel monophasic action potential electrode array for in vivo epicardial repolarization mapping," IEEE Transactions on Biomedical Engineering, 48(3), pp. 345-353, 2001.
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56) D.K. Serkland, G.D. Bartolini, W.L. Kath, Prem Kumar, and A.V. Sahakian, "Rate multiplication of a 59-GHz Soliton Source at 1550 nm," IEEE/OSA Journal of Lightwave Technology, 16(4), pp. 670-677, 1998.
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64) H.J. Sih, A.V. Sahakian, C.E. Arentzen and S.Swiryn, "A frequency domain analysis of epicardial maps," IEEE Transactions on Biomedical Engineering, 42(7), pp. 718-727, 1995.
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TEXTBOOK CHAPTERS AND SECTIONS:

1) S. Petrutiu, G. Nijm, J. Ng, S. Swiryn and A.V. Sahakian "Time Domain Description of Atrial Fibrillation," in "Atrial Fibrillation, a Signal Processing Perspective" L. Sornmo and S. Cerutti, Eds., Morgan and Claypool, 2008.
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9) U.S. Patent # 9,186,103: “System and Method for Spin Logic,” co-inventor with Joseph S. Friedman and Bruce W. Wessels, November 17, 2015.
10) European Patent WO/2003/061759: “Methods and Apparatus for Detection and Treatment of Syncope,” Granted April 18, 2007.
11) U.S. Patent # 6,895,275: “Methods and apparatus for detection and treatment of syncope,” co-inventor with H.T. Markowitz, M.K. Erickson and A. Schuler, issued May 17, 2005.
12) U.S. Patent # 6,061,589: “Microwave antenna for cancer detection system,” co-inventor with J.E. Bridges, A. Taflove and S.C. Hagness, Issued May 9, 2000.

Provisional and Applications:

1) USPTO Application 20180235686: “Systems and methods for ablation status monitoring and custom ablation shaping,” with Yearnchee (Curtis) Wang and Terence Chan.
2) US Provisional NU 2013-097 “All-Carbon Spin Logic,” Alan Sahakian, Bruce Wessels and Joseph Friedman.

Recent Talks *(Selected items)*

1) Northwestern University/Tel-Aviv University Joint Workshop, “Spintronic and Magneto-Resistive Logic for Beyond-CMOS Computing,” July 17, 2018.
2) IEEE Region-4 Big Data Workshop, Plenary talk, October 25, 2017.
3) “Spintronic and Magneto-Resistive Logic for Beyond CMOS Computing” Physics and Astronomy colloquium, Northwestern University, January 15, 2016.
4) Invited keynote talk “Spintronic and Magneto-Resistive Logic for Beyond CMOS Computing,” IEEE International Conference on Electro/Information Technology, Naperville, IL, May 23, 2015.
5) “Magnetoresistance Implications for Complementary Magnetic Tunnel Junction Logic (CMAT),” IEEE/ACM Nanoscale Architecture (NanoArch) Conference, Boston, MA, July 9, 2015.

6) "Spintronic and Magneto-Resistive Logic for Beyond CMOS Computing," Distinguished Lecture in ECE, IIT, Chicago, IL, September 4, 2015.
7) "American Sign Language: Foundations and Basic Structure," Language and Cognition Seminar, Northwestern University, October 18, 2010. The first in a series of three lectures on ASL organized by Alan Sahakian.

SCIENTIFIC AND PROFESSIONAL SOCIETY MEMBERSHIPS:

Institute of Electrical and Electronics Engineers - IEEE (Life Fellow) and IEEE Engineering in Medicine and Biology Society, Microwave Theory and Techniques Society, Antennas and Propagation Society, Computer Society.
Association for Computing Machinery - ACM (Senior Member)
American Institute for Medical and Biological Engineering - AIMBE (Fellow)
Asia Pacific Artificial Intelligence Association (Fellow)
Eta Kappa Nu – HKN, Electrical and Computer Engineering Honors Society
American Society for Engineering Education- ASEE (member and Northwestern University campus representative).

CURRENT EDITORIAL ACTIVITIES

Associate Editor for IEEE Transactions on Biomedical Engineering (2012-present)
Editorial Board member for Scientific Reviews (Nature Publishing) for the area of Electronics, Photonics and Device Physics (2016-present)

POSITIONS WITHIN PROFESSIONAL SOCIETIES

IEEE: Distinguished Lecturer, EMBS (1993-2011)
IEEE EMBS Fellows Committee (2003-2005 and 2006-2007)
Advisory Board: IEEE Transactions on Information Technology in Biomedicine (1998-2011)
Steering Committee, IEEE Transactions on Medical Imaging (1998 through 2000)
Vice President for Publications and Technical Activities of the Engineering in Medicine and Biology Society (EMBS) (1996 and 1997/1998 terms)
Region-4 (north-central US) Administrative Committee (AdCom) representative for EMBS (1993/95 and 95/97 terms)
Chair, Emerging Technologies Committee, EMBS (1993 through 1995).
Chair, Publications Committee, EMBS (1996 through 1998)
Member and Chapter Activities Committee, EMBS (1993 through 1997).
Student activities committee, EMBS (1993 through 1997).
Biomedical Engineering Society: Editorial Board, Instrumentation section, for the Annals of Biomedical Engineering, (1990-93).

Recent reviewer for:

IEEE Transactions on Biomedical Engineering, IEEE Transactions on Medical Imaging, IEEE Transactions on Information Technology in Biomedicine, npj Digital Medicine, Annals of Biomedical Engineering, Medical and Biological Engineering and Computing, Circulation,

Biotechnology Progress, Medical Engineering and Physics, IEEE Transactions on Electron Devices.

AWARDS / CHAIRS

Allen Taflove Best Teacher Award, Northwestern ECE Department, June 2022.
John A. Dever Professor of Electrical Engineering and Computer Science, 2015-2018.
Charles Deering McCormick Chaired Professorship in Teaching Excellence, 1999-2002.
Associated Student Government (ASG) faculty honor roll for years 1996, 1997, 2002 and 2012.
McCormick School of Engineering and Applied Science Advisor of the Year Award, 1995-96.
Bette and Neison Harris Chaired Professorship in Teaching Excellence, 1993-95.
Northwestern University Alumni Association: Award for Teaching Excellence, 1992.
McCormick School of Engineering and Applied Science Award for Teaching Excellence, 1990.
McCormick School of Engineering and Applied Science Teaching Honor Roll, 1990.

OTHER HONORS/AWARDS:

2023: Named a Fellow of the Asia Pacific Artificial Intelligence Association
2012-13: CIC (Big-Ten Academic Alliance) Academic Leadership Program Fellow
2011: Elected a Fellow of AIMBE "For contributions to electrophysiology of atrial cardiac arrhythmias"
2007: Elected a Fellow of IEEE "For contributions to electrophysiology of atrial cardiac arrhythmias'
1996: Distinguished Alumnus and Outstanding Achievement Awards, University of Wisconsin - Parkside.
1995: Outstanding IEEE Student Branch Advisor, Region-4.

RESEARCH SUPPORT:

CURRENT:

From the NIH NINDS: Project Number 1R21NS120166-01A1, co-PI, with Matthieu Chardon as primary PI: "Modern approach to electrical conductivity mapping of spinal cord tissues," Feb 15, 2022 to Jan 31, 2023.

From the Dixon Translational Research Grants Initiative (NM Foundation), Co-I with Rishi Arora (PI), Daniel Lee, Rod Passman and Daniel Kim (Co-I), "Development of a New, Mechanism Guided Therapeutic Strategy for Atrial Fibrillation", three years, to start Fall 2022.

From the NSF STTR Phase II 1738541 (co-investigator with Robert Rioux of Innoblative Designs, LLC): "Automated system for creating custom three-dimensional radiofrequency ablation lesion geometries in post-lumpectomy margin ablation breast cancer treatment," $583,417 from 9/15/2017 to 2/29/2020 (in extension, awaiting Innoblative Designs subcontract fulfillment to Northwestern).

COMPLETED:

From the NIH: R01 CA196967, Co-investigator with Drs. Andrew Larson and Zhuli Zhang: "MRI-Guided Irreversible Electroporation Ablation for Liver Tumors," 07/01/15 – 6/30/19.

From the NSF Award 1622842: STTR Phase I (with Innoblative Designs): "Automated system for creating custom three-dimensional radiofrequency ablation lesion geometries in post-lumpectomy margin ablation breast cancer treatment," July 1, 2016 to June 30, 2017.

From the NIH: U01 EB020589: Co-investigator with Professor Sanjay Mehrotra: "Unassisted Blood Pressure Monitoring using Arterial Tonometry and Photoplethysmography," 09/30/15 – 07/31/17.

From the NIH: Award Number K12GM088020: "Northwestern University-Select Teaching and Research Training (NU-STAR) Program" co-PI with Lawrence Henschen.

From the NIH: "MRI for In-Vivo Quantification of Y-90 Micropheres" (F-31 with Andrew Larson and Oyenlolu Adeyanju).

From the Defense Intelligence Agency (subcontract from Argonne National Labs), Remote Detection of Intent, co-pi at NU.

From the Department of Defense, "Nanoparticle Contrast Agents for Enhanced Microwave Imaging and Thermal Treatment of Breast Cancer'" $506,537, September, 2007 – October, 2009, Co-investigator with Xu Li as PI.

From Intel: Improving Bit-Rate, Noise Performance and Power Dissipation of On-Chip Buses, Intel Corporation, (NUFinancials Award # CNV0035067, Project # 60016633, end date 3/31/2014)

From Intel: Improving the Accuracy of Timing Verification Tools, Intel Corporation, (NUFinancials Award # CNV0035773, Project # 60016636, end date 8/31/2014)

From Intel: Simultaneous Co-Design of Clock and Power Distribution Networks, Intel Corporation, (NUFinancials Award # CNV0060383, Project # 60019567, end date 9/30/2014)

From Intel: Interconnect Design for Many-Core and 3-D Chips, Intel Corporation, (NUFinancials Award # CNV0051858, Project # 60016680, end date 5/31/2015)

From Honeywell, Inc. (through Segal Design Institute), SafeCar vehicle for first-responders (undergrad research/design).

From the Dr. Scholl Foundation, "Mechanisms of Atrial Fibrillation, a Study Focusing on Issues of Repolarization," Cumulative: $342,600 through 11/2009, Co-PI with Steven Swiryn.

From the National Science Foundation through the VaNTH Center: "A module teaching principles of Cardiovascular Signal Processing," and "A module teaching principles of magnetic resonance imaging using a bench-top instrument" Approx. $250,000, through 8/2007.

From Medtronic, Inc., "Signal processing for implantable cardiac pacemakers" Cumulative: $281,000, through 10/2007.

From the Defense Advanced Research Project Agency (DARPA), "Lightweight cryptographic techniques," Co-PI with Horace Yuen and Majid Sarrafzadeh, $967,043, 6/1/00 – 5/01/03.

From the O'Shaughnessy Foundation, "Instrumentation to correlate body position with cardiac arrhythmias in ambulatory patients," $25,000, (co-investigator with S. Swiryn), 12/1/99 through 11/30/00.

From AT+T/Lucent Technologies, Special Purpose Grant to Establish a Multidisciplinary Laboratory for the Development of Technology for Optical Video Networks, $65,000, (with P. Kumar and A. Katsaggelos as co-PI's), 11/96 through 10/97.

From the NIH, "Microwave Breast Cancer Detection," (SBIR grant subcontract from Interstitial, Inc, with J. Bridges and A. Taflove), 6/96 through 7/97.

From the Federal Aviation Administration, "Image Processing for Radiographic Inspection" through the Center for Aviation Systems Reliability, Iowa State University, $120,000, 9/90 through 2/95.

From Siemens: "Processing enhancements for digital angiographic image sequences," (with A. Katsaggelos as co-investigator), $276,827, 12/1/89 through 12/31/92.

From Siemens: Photoelectron-statistic-limited X- ray angiography, (with A. Katsaggelos and B. Sullivan as co-investigators), $18,000, 5/1/89 through 11/30/89.

From the Microelectronics Systems Center: "Multi-processor for modeling complex two-dimensional arrays in matrix representations," $2,500, 10/1/88 - 9/30/89.

From Evanston Hospital "Atrial fibrillation: studies from atrial electrograms," (co-investigator with S. Swiryn), $32,598, 12/1/87 through 11/30/88.

From Cardiac Pacemakers, Inc. (St. Paul, MN) "Conversion of atrial fibrillation using low-energy intra-atrial countershocks," (co-investigator with J.M. Baerman), $10,000, 10/1/87 through 12/31/87.

From University Research Grants Committee: "Algorithm studies for long-term neonatal apnea monitoring," $2,000, 6/1/85 through 5/31/86.

GRADUATE STUDENT ADVISEES:

ADVISEES HAVING COMPLETED DEGREES:

Janet Slocum (***Ph.D.*** EE completed 5/86). Thesis title: "Computer detection of A-V dissociation and atrial fibrillation."
Albrecht Baur (***M.S.*** EE completed 8/85). Project title: "Data compression of the impedance pneumogram."
Kuo-Hua Kuo (***M.S.*** EE completed 12/85). Project title: "A software package for the acquisition and analysis of the impedance pneumogram."
Brian Matsumoto (***M.S.*** BME completed 8/87) Thesis title: "Instrumentation for the acquisition and analysis of heart-rate variability data."
Nicos Maglaveras (***Ph.D.*** EE completed 10/87) Thesis title: "Computer modeling of propagating cardiac action potentials in one and two dimensional tissue using finite elements."
James Varelis (***M.S.*** BME completed 6/87) Thesis title: "On the relationship between potential and impedance motion artifacts in silver/silver chloride surface electrodes."
Jacob Weinrib (***M.S.*** CS completed 1/87) Project title: "Evaluation of a significant-point extraction algorithm for ECG data compression."
Hala Medawar (***M.S.*** EE completed 12/87) Project title: "Design of a pulse oximeter."
Kristina Ropella (nee Piacsek) (***M.S.*** BME completed 6/87) Thesis title: "The effects of procainamide on intra-atrial electrograms during atrial fibrillation," (***Ph.D.*** BME completed 11/89) Thesis title: "Bivariate analysis of cardiac rhythms,"
Joel Kirsh (***M.S.*** BME completed 6/88) Thesis title: "Ventricular response to atrial fibrillation: role of atrioventricular conduction pathways."
Wei-Dee Hsiao (***M.S.*** EE completed 12/88) Project title: "Theoretical and experimental studies for improved pulse oximetry."
David Zung (***M.S.*** EE completed 12/88) Project title: "Design and implementation of a pulse oximeter utilizing a pseudo-random binary sequence generator."
Pamela Gross, M.D. (***Ph.D.*** BME completed 6/89) Thesis title: "The use of a piezoelectric polymer transducer to study the frequency partition of chest wall sounds."
Bernice Kauffman (***M.S.*** BME completed 9/89) Thesis title: "An automated investigation of somatosensory evoked potential evaluation in cervical spondylosis myelopathy."
Ibrahim Ajami (***M.S.*** EE completed 12/89) Project title: "Detection of A-V dissociation in wide-QRS-complex tachycardias using median-event cancellation and Hilbert-transformed autocorrelation analysis."
Haris Sih (***M.S.*** EE completed 12/90) Thesis title: "Effects of uniform anisotropy on wavelet fractionation and effects of refractoriness dispersion on electrogram calculations in a computer model of a fibrillating cardiac tissue sheet." (***Ph.D.*** EE Completed 12/94) Thesis title: Coherence mapping of cardiac tissue and its application to atrial fibrillation.
Seung-Jae Lee (***M.S.*** EE completed 6/92) Thesis title: "A computer model of radiographic image formation." (***Ph.D.*** EE completed 12/97) Thesis title: Resolution enhancement of image sequence using motion-compensated sub-pixel registration and interpolation.
Mary Sue Reinert (***M.S.*** EE completed 12/92) Thesis title: "A comparison of three techniques for magnitude-squared coherence estimation of simulated data and cardiac electrograms."

Edward Gerstenfeld, MD, (***M.S.*** BME completed 6/93), "Detection of patterns in atrial endocardial activation during sinus rhythm, retrograde conduction, and atrial fibrillation with use of an orthogonal catheter."
Akila Srinivasan (***M.S.*** BME completed 5/93), "Intra-atrial electrograms in comparison with respiratory activity and surface electrocardiograms during atrial fibrillation."
Cheuk Chan (***Ph.D.*** EE Completed 7/93) "Image sequence filtering and displacement field estimation under quantum-limited imaging conditions."
Daniel Levy (***M.S.*** CS Completed 6/94) Thesis title: A Unix/Dos disk sharing system.
Kok-Hwee Ng (***Ph.D.*** BME Completed 12/94) Thesis title: Arterial tissue characterization by intravascular ultrasound radio frequency signal analysis.
Adam Schoenwald (***M.S.*** BME Completed 12/94) Thesis title: Observations on linking of atrial activation from long-term three-dimensional endocardial recordings during atrial fibrillation.
Stephanie Shors (***M.S.*** BME Completed 5/95) Thesis title: A method for determining high-resolution activation time delays in atrial myocardium.
Irfan Lateef (***M.S.*** BME Completed 5/96) Thesis title: Validation of a multi-site monophasic action potential mapping electrode array.
Sergio Shkurovich (***M.S.*** BME completed 11/96) Thesis title: Detection of atrial activity from high-voltage leads of implantable cardioverter defibrillators using a cancellation technique. (***Ph.D.*** BME completed 6/2001) Thesis title: Monophasic action potential mapping of atrial repolarization.
Ming-Shing Lee-Peterson (***M.S.*** BME completed 6/97) Thesis title: A simultaneous multi-channel monophasic action potential electrode array for epicardial repolarization mapping.
Mingchun Li (***M.S.*** ECE completed 12/99) (Non-thesis degree)
Andreas Schuler (***M.S.*** ECE completed 6/2001) Thesis title:
Jason Ng (***M.S.*** ECE Completed 6/2001) Thesis title: Sensing and documentation of body position during ambulatory ecg monitoring, (***Ph.D.*** ECE completed 6/2004) Thesis title: Multidimensional analysis of atrial fibrillation and flutter
Qin (Cecilia) Xi (***Ph.D.*** BME completed 9/2003) Thesis title: Analyzing atrial activity in surface electrocardiograms to determine mechanisms of atrial fibrillation and flutter.
Emin Oral (***Ph.D.*** ECE completed 6/2004) Thesis title: A computational study of reconstruction algorithms for ultra-wideband electromagnetic pulse imaging in tissue
Brian Craig (non-thesis ***M.S.*** BME completed June 2004)
Chris Hayes (non-thesis ***M.S.*** BME completed June 2004)
Amit Sharma (non-thesis ***M.S.*** BME completed August 2004)
Marisa Ruffolo (***Ph.D.*** ECE completed 6/2005) Thesis title: The development of storage requirements and the analysis of optimal storage placement for a federated digital medical imaging network.
Haitham al Angari (***Ph.D.*** ECE completed 12/05) Thesis title: Studies of the Cardiorespiratory Interaction in Obstructive Sleep Apnea Syndrome (OSAS).
Maria Guillem de la salud Sanchez (non-thesis ***M.S.*** BME completed 6/06) (Fulbright Fellow from Universidad Polytechnica de Valencia Spain)
Markus Billeter (Visiting Scholar) ***Master of Science*** in Electrical Engineering and Information Technology, Eidgenossusche Technische Hochschule Zurich, Thesis title: Laboratory Demonstration of Spatial Encoding in MRI.
Grace M. Nijm (***M.S.*** ECE completed 6/06) Thesis title: Characterization of the Magnetohydrodynamic Effect in the Surface ECG during MRI, (***Ph.D.*** ECE completed June 2009)

Thesis title: “Signal processing of gating signals for cardiac MRI and computational modeling of magnetohydrodynamic blood flow potentials”
Simona Petrutiu (***Ph.D.*** ECE completed 6/08) Thesis title: Frequency Domain Analysis of the Surface Electrocardiogram and Intracardiac Electrograms: Insights into the Mechanisms of Atrial Fibrillation
Jonathon Koenig (***M.S.*** ECE completed June 2010) Thesis Title: “Observations of pacemaker Pulses in High Bandwidth Electrocardiograms and Dower-estimated Vectorcardiograms”
Wendy Yip (***Ph.D.*** EE completed June 2012) Thesis title: “Investigation of electromagnetic properties of multi-particle systems in the optical and microwave regions”
Oyenlolu (Lolu) Adeyanju (***Ph.D.*** BME completed June 2012, ***M.D.*** completed June 2014) Thesis title: “The optimization of irreversible electroporation to treat hepatocellular carcinoma”
Ilya Mikhelson (***Ph.D.*** EE completed June 2013) Thesis title: “Real-time detection and tracking of vital signs with an ambulatory subject using millimeter-wave interferometry”
Erdem Cicek (***Ph.D.*** in EE completed September 2014)
Joseph Shimon Friedman (***Ph.D.*** Computer Engineering completed June 2014) Thesis Title: “Cascaded Magnetoresistive Spintronic Computing”
Curtis Wang (***Ph.D.*** in Computer Engineering completed June 2019) Thesis Title: “Real-time Control in Embedded Systems using Deep Neural Network-based Estimation Applied to Joule Heating”
Emre Besler (**Ph.D.** in Electrical Engineering completed June 2021) Thesis Title: “Monitoring Ablation Therapy Using Ensemble Learning Models”

TEACHING AND COMMITTEE ACTIVITIES AT NORTHWESTERN UNIVERSITY:

Courses Taught:

EECS 106: Introduction to Electrical Engineering
EECS 201: Fundamentals of Computer Organization
EECS 202: Introduction to Electrical Engineering
EECS 203: Introduction to Computer Engineering
EECS 205: Systems Software (Assembly Language)
EECS 225: Fundamentals of Electronic Circuits
EECS 306: Electronic Circuits
EECS 316: Mini/Microcomputers and Real Time Applications
EECS 346: Microprocessor System Design
EECS 353: Digital Microelectronics
EECS 377/ BME 384: Biomedical Computing
EECS 395/495/ BME 383: Cardiovascular Instrumentation
EECS 401: Fundamentals of Electronic Devices (co-taught)
BME 325: Introduction to Medical Imaging
BME 395: Advanced Medical Instrumentation
GTK 106: Engineering Design and Communication (co-taught)
CAS 380-7: American Sign Language and Deaf Culture (three-quarter sequence, co-taught)

MISCELLANEOUS COMMITTEES AND SERVICES AT NORTHWESTERN UNIVERSITY:

2022-present	Faculty Advisor for the Northwestern University Armenian Student Association
2022-present	Faculty Advisor for the Northwestern University Billiards Club
2021-present	Faculty Advisor for the Northwestern Chapter (Beta Tau) of Eta Kappa Nu, the Electrical and Computer Engineering Honors Society
2007-2010	General Faculty Committee Representative for the McCormick School of Engineering and Applied Science
2007-present	Northwestern Center for Engineering Education Research
2001-2009	Board of Directors for Motorola Center for Seamless Communications
2000-2011	Northwestern Conciliation Council
1999-present	Fellow of the Searle Center for Teaching Excellence
1997-2004	McCormick Co-operative Education Steering Committee
1997-2003	Northwestern Community Council (NCC)
1997-1999	Executive Board, University Faculty Reappointment, Promotion and Tenure-Denial Appeal Panel (UFRPTDAP)
1995-2000	Master of the Lindgren Residential College of Science and Engineering
1994-2001	Northwestern University delegate to American Association for Higher Education (AAHE) project on peer evaluation of teaching
1993-1999	Steering Committee for Searle Center for Teaching Excellence
1993-1994	McCormick Committee on our Future
1993-1995	McCormick Committee on Excellence
1993-1995 and 1996-1998	Elected Member, UFRPTDAP
1992-1993	Chairman of McCormick Teaching and Advising Awards Committee
1991-1998	Chairman of EE Curriculum Committee
1991-2000	Faculty co-advisor, McCormick Design Competition
1991-1995	Faculty Associate to the Lindgren Residential College of Science and Engineering
1990-1998	EE Dept. representative on McCormick Curriculum Committee
1986-1998	Honors Program in Medical Education (seven-year BS/MD) Admissions Committee (alternating years)
1986-1998	EE Laboratory Budget Committee
1986-2000	BME Undergraduate Curriculum Committee
1986-present	IEEE student branch counselor and advisor
1985-1987	EE Ph.D. Qualifying Examination Committee
1985-present	Faculty advisor or co-advisor to N.U. Amateur Radio Society (W9BGX)
1984-1991	EE Program Committee

OTHER COMMITTEES:

2018	Organizing committee for IEEE Region-4 Big Data Workshop
2011-present	Editorial Board for IEEE Transactions on Biomedical Engineering
2002-2004	Organizing Committee for the 2004 Computers in Cardiology Conference
1995-2001	Steering Committee for the Chicago Section IEEE EMBS
1995-1997	Organizing Committee for the 1997 EMBS conference
1998-1999	Publications co-chair for 1999 IEEE Biosignal Interpretation Workshop