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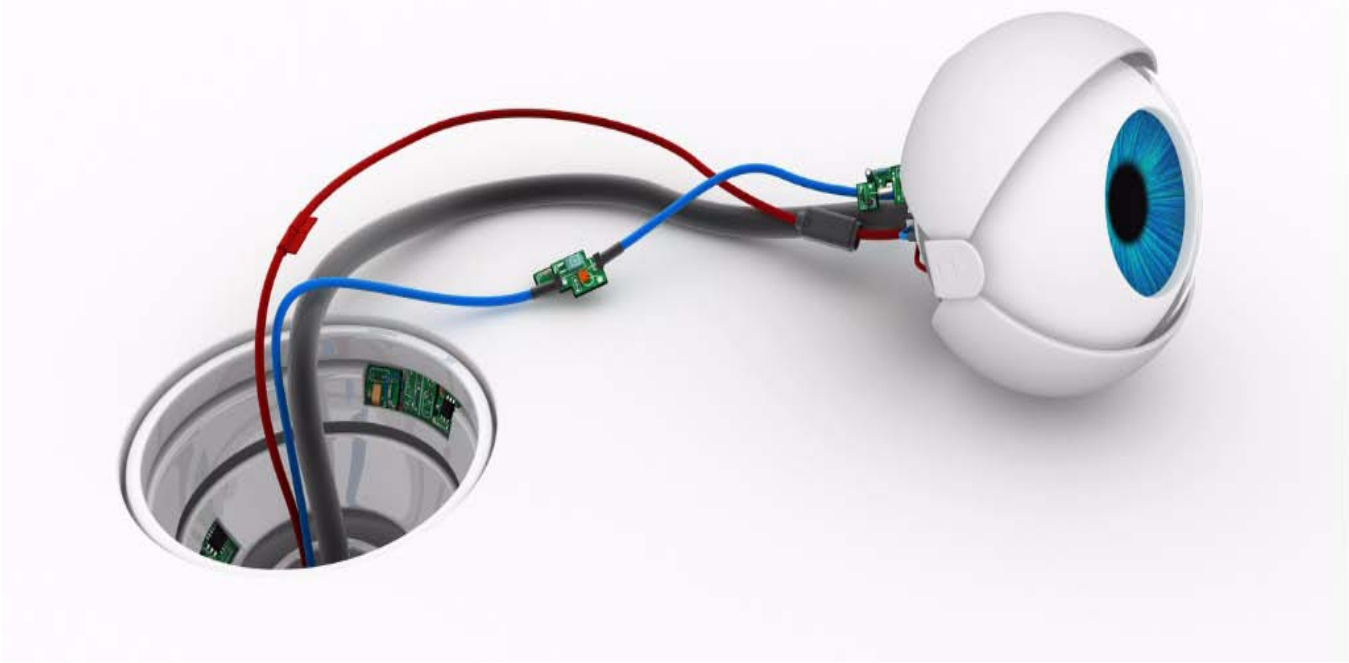

IEEE
Advancing Technology for Humanity

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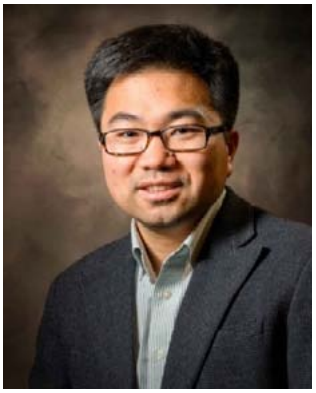

Touch Down Confirmed. We are Safe on Mars!

by Rui Ma, Secretary/Treasurer, IEEE Boston Section

On February 18th, 2021, when I was scratching my head trying to figure out what I should write for this March editorial with the deadline looming, my son and I, as many of us, watched the thrilling video on NASA's Perseverance successful landing on Mars. "Touchdown confirmed! Perseverance is safely on the surface of Mars, ready to begin seeking the signs of past life!" the control officer monitoring telemetry at the Jet Propulsion Laboratory, called out as the rover touched down.

Perseverance is the successor of NASA's rover Curiosity which landed on August 6th, 2012 and is still operational as of today but at a different zone from Jezero. At this time, the ideal Jezero carter landing location is chosen for its possibility of once harboring life in ancient times but much more challenging and riskier to land. It had to be given up for the previous landing of Curiosity due to the technology limitation we had 8 years ago. One has witnessed how technology has transformed life, our planet, and now space. Today, NASA can equip the new rover with the latest innovation from Earth including MOXIE (converting from carbon dioxide to oxygen), Ingenuity helicopter (the first time a drone was brought outside our planet), nuclear power, new LIDAR sensing technologies, and navigation assisted with artificial intelligence. The list goes on and on. These lead to dramatically improved accuracy and capabilities. What a marvelous achievement!

However, we sometimes also hear the comments "Why we spend money on space when we still have tons of burning problems to solve on Earth?". We indeed need to address the challenges and issues in our daily life and on the ground. It is equally important if not more, that we too look at the space, such as to look for another habitable planet to possibly migrate our future generations. Besides, one of the fundamental drives is for exploration and imagination. Keep asking the kind of questions kids ask is essential for scientific advancement. As the names of the Mars rovers from NASA suggest, "Pathfinder", "Curiosity", and "Perseverance" are the characteristics we are proud of. These are the shining and everlasting merits built-in mankind DNA. Perseverance is needed to explore Mars for evidence of life and is needed on Earth to overcome COVID as well.

Mars recently became popular for space exploration, as the UAE and China's rovers are also orbiting it. I cannot agree more with the CBS moderator in the program of Spacewatch. The moderator said: "Space exploration always reminds us there are more things that bind us together than separate us. We have to work together to accomplish something like this, across country lines, ideological lines. Humanness and curiosity are what keep us together." I think it is also well expressed in the IEEE tagline Advancing technologies for Humanity.

I encourage you to take a look at the first image in color sent back from Perseverance (https://www.nasa.gov/image-feature/jpl/perseverance-s-first-full-color-look-at-mars) and share the excitement. Be safe and persistent, as we see the light at the end of the tunnel of COVID, with the deployment of vaccines. This is certainly another amazing technological achievement for mankind!

Join the experts in the Artificial Intelligence field as they share their expertise and knowledge to other technologists, engineers and scientists

Dr. Ken Washington is chief technology officer, Ford Motor Company, and part of the enterprise leadership team reporting to Hau Thai-Tang, Ford's chief product platform and operations officer.

Ford Motor Company AI Journey – Status & Trends: This presentation reviews some of the main directions in AI at Ford. The focus is on the use of data, analytics, and AI as key enablers of the plan for modernizing Ford Motor Company operations. The disruptive role of AI in the digital transformation of Ford in a time of unprecedented change in vehicle technology, mobility and connectivity is discussed. Examples of applications to vehicle engineering, delivery of personalized mobility experiences and business practices are reviewed. The presentation concludes with the lessons learned and future trends in integrating AI technologies within the design of modern vehicles and services.

LEARN MORE:
http://ieeeboston.org/artificial-intelligence-webinar-series/

IEEEBoston.org

Date:
March 17, 2021

Time:
10:30AM – 12:00PM (ET)

Cost:
IEEE Members: $25.
Non-members: $35.
Full-time undergrad and grad students are free

Future Dates:
April 20, 2021
June 23, 2021

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Fundamental Mathematics Concepts Relating to Electromagnetics
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Reliability Engineering for the Business World
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Design Thinking for Today's Technical Work
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Fundamentals of Real-Time Operating Systems
http://ieeeboston.org/fundamentals-of-real-time-operating-systems-rt201-on-line-course/

Electric Vehicles – Having Fun Saving the Planet

The Boston Section of the IEEE has added to its Presentation Video Archives an hour-long program entitled "Electric Vehicles – Having Fun Saving the Planet." It is moderated by Boston/New England Emmy Award-winner John Horrigan.

The program includes hands-on experience with the Tesla Model 3 by Len Long, along with presentations on the Tesla Model S by Dr. Ken Laker, the Chevrolet Bolt by Dr. Paul Carr and commentary by Dr. Ted Kochanski.

Here is the URL where this program currently resides: Presentation Archives - IEEE Boston. This program reveals unknown electric vehicle facts about electric vehicles to owners of internal combustion automobiles and gives compelling reasons for owning one.

Entrepreneur's Network – 7:00PM – Tuesday, March 2

PIVOTING: WHY, WHEN, AND HOW

ONLINE WEBINAR

Registration:
https://boston-enet.org/event-3892680/Registration
ENET Member: Free
Non-Members – $10.00

For the founder and entrepreneur launching a startup company, as well as the CEO and officers in a startup or early stage company, it is important to understand the market for your products or services, the needs of your customers and the value proposition you offer, and to be able to make adjustments and even radical changes of direction as facts and circumstances warrant.

That ability to make the needed adjustments and more radical changes to address the current market and customer needs is often called pivoting and the ability to pivot.

For angel investors and VCs, generally the most important thing they look for in a potential startup or early stage company investment, is the quality of the CEO and management team. That is true in tech, life science, e-commerce and across the board, but most true in the evolving world of the innovation economy. And one of the big reasons investors place so much emphasis on the quality of management, is that surprises happen, things seldom go according to script. The quality CEO will recognize when the business plan is just not working. If mistakes are made, the wise CEO recognizes the mistake in timely fashion, then promptly makes the needed pivot before too much time and money is lost – to find the right approach, and to do so more than once as needed until the company is back on course and succeeding in its mission.

Pivoting and its importance to the startup and early stage companies has become all the more critical in these fast changing times as result or the enormous changes wrought on business, the economy and everyone lives as result of the COVID-19 pandemic.

On March 2, 2021, PIVOTING is the topic for our ENET webinar panel.

To address this topic, ENET will present three CEO speakers, all with much experience to share from successful pivots they led and achieved in their startup and early stage companies, plus lessons they have learned and will share with us. Some of the experiences shared will include pivoting in the face of COVID-19. Our speakers are all founders and CEOs, one in life sciences, one in tech, and a third with a company that provides a mobile app launching platform for nonprofits. Additionally, one of our three speakers is also an angel investor. Our moderator and chief meeting organizer is Boston attorney and ENET Chair Emeritus Rob Adelson.

Hope you will join us for this timely ENET webinar 7-830pm ET on March 2, and perhaps for online networking before and after the speakers. The webinar will include 20 minutes of audience and moderator Q and A. In the second round of networking 830-9pm, you will have the chance to join tables of four with each of the three speakers and our moderator at four separate tables. This gives you a second chance for follow-on questions and to further get to know our speakers in a more personal way.

Agenda:
5:30 – 6:45 – Networking on Grapevine Network
7:00 - 7:10 PM - ENET Chairperson's announcements
7:10 - 7:25 PM – eMinute Pitch - Up to 3 Startup companies' presentations
7:25 - 8:10 PM - expert speakers on the night's topic
8:10 - 8:30 PM – Moderator and Audience Q & A with the speakers
8:30 – 9:00 PM - Networking on Grapevine Network
(all times are USA Eastern Daylight time)
A question and answer session will follow the panel discussion, and panelists will be available afterward for responses to individual questions.

Speakers:

Morgan Berman, Founder & CEO @ MilkCrate, powering program engagement and impact tracking for nonprofits. Morgan is an internationally award-winning entrepreneur and local community leader in Philadelphia. She is the founder and CEO of MilkCrate - a mission driven tech company helping other mission driven organizations achieve their impact goals. Their platform powers the apps for some of the world's leading nonprofits and municipal programs. She has presented at Forbes 30 Under 30, was listed by the UN Foundation as one of the "Top 10 Female Entrepreneurs to Watch" in the world and invited to the White House for Clean Energy Plan talks. She has been a World Economic Forum Global Shaper, a Fellow at the Ariane de Rothschild Fellowship, and an Environmental Leadership Program Senior Fellow. She regularly travels the country sharing her story as a female tech founder, B Corp leader, and jiu jitsu fighter. Some of her favorites have been presenting at Grace Hopper, keynoting for Wharton's Social Impact Summit, and giving the Cum Laude speech at her high school alma mater. In her free time she mentors young entrepreneurs, helps other mission driven groups, and competes in Brazilian Jiu Jitsu.
https://www.linkedin.com/in/morganberman/

Johannes Fruehauf, MD, Founder, CEO LabCentral/Biolabs. Partner at Mission BioCapital. Biotechnology entrepreneur and investor with a track record of building and growing successful companies. Physician-scientist experienced in the development of complex biologics programs from bench into the clinic, including the first oral RNAi drug to enter the clinic. Co-founder and General Partner at BioInnovation Capital, now Mission BioCapital. .Founder/Co-founder of LabCentral, Cambridge Biolabs, BioLabs North Carolina, Philadelphia, San Diego, New York, Princeton, Tufts, Los Angeles; BioInnovation Capital, ViThera, Cequent, German Life Science Accelerator. Specialties: Company building, Structure of Innovation, Venture Capital, Biologics development, translational science, clinical trials, drug delivery, oligonucleotide therapeutics, startup financing, preclinical and clinical development, technology licensing and development, entrepreneurship, international relations.
https://www.linkedin.com/in/johannesfruehauf/

Mark Karsdorf, CEO and Founder @ Intrepid Homes. Cambridge based entrepreneur. Founder of Intrepid, a software development studio acquired by Accenture in 2017 as well as Timbre (live music discovery app) and Intrepid Labs (Kendall Sq based coworking studio). His career goals have been and remain to build successful companies in the thriving Boston/Cambridge community, and to help others do the same. His prior company from 2010 to 2020, where he was CEO and Founder was a software contracting firm, specialized in iOS development and have done a variety of projects, large and small, across the iPhone, iTouch, and iPad platforms.
https://www.linkedin.com/in/markkasdorf/

Moderator and Chief Organizer

Robert A. Adelson, Principal, Business and Tax attorney @ Adelson & Associates, LLC. Chair Emeritus @ Boston Entrepreneurs' Network (ENET).
Rob has been an attorney for over 30 years specialized in business, tax, stock and options, employment, contracts, financing, trademarks and intellectual property. Rob began as an associate at major New York City law firms before returning home to Boston in 1985 where he has since been a partner in small and medium sized firms before joining Engel & Schultz LLP where he was a partner from 2004 to 2019. When the senior partners retired, he moved his law practice to his own firm, effective 1/1/2020. Rob represents entrepreneurs, start-ups and small companies, independent contractors and employees and executives. Rob is a frequent speaker on business law topics and author of numerous articles published in Boston Business Journal, Mass High Tech and other publications, plus more than twenty articles since 2016 on executive employment topics published by CEOWorld magazine.

He has been named among the "Top 20 Boston Startup Lawyers" by ChubbyBrain.com, a website that provides tools for entrepreneurs. Rob has been on the ENET Board since 2002, was Vice Chair 2005-2009, and ENET Chairman 2009-2019. He was also a Co-Founder and Board member of the 128 Innovation Capital Group (2004 -2015). In 2016, he received the IEEE USA Professional Achievement award for "extreme dedication to the entrepreneurship community." He holds degrees from Boston University, B.A., summa cum laude, Northwestern University (Chicago), J.D., Law Review, and

New York University, LL.M. in Taxation.
https://www.linkedin.com/in/robert-adelson-b8a1557/

Co-Organizer

Prithvi Tanwar, Partner @ Polsinelli. Prithvi serves as general corporate counsel to early and growth stage technology companies that are building innovative products and services that are changing business processes and the way individuals use and interact with technology on a daily basis. Increasingly, his law practice involves representing companies that have built mature teams and stable products overseas and are seeking to have a legal presence in the US to raise venture capital from US sources or access to the US market while still retaining their foreign operations. Previously, Prithvi was a Partner at Foley Hoag LLP, where he was an attorney from 2008 to 2019, in Corporate Business Practice, Venture Capital Financing & Emerging Companies.

Women in Engineering and Communications Society - 6:30PM, Tuesday, March 9

Communications Prototyping with MITRE

Location: Zoom (link to be sent to registrants later)

Join MITRE for a virtual tech talk starting at 6:30PM on Tuesday, March 9 th. MITRE engineers will deliver presentations on acoustic communication systems for underwater data transfer and on a GPU platform for signals analysis as part of our active research programs. Each of these presentations will highlight the ways that software defined radios are paired with general purpose and heterogeneous processing environments to rapidly prototype tailored digital signals processing capabilities. Following the two presentations, there will be optional breakout rooms where the speakers will be available for questions and networking.
These presentations will be given by Dr. Tamara Sobers, Wayne McLaggan, and Jeremy Martin.

Agenda:
[5 minutes] Opening Remarks and Introduction - Maira Samary, IEEE WIE Boston Chair
[20 minutes] TechAnical Presentation 1 - Acoustic Communications - Dr. Tamara Sobers
[20 minutes] Technical presentation 2 - Photon - Wayne McLaggan and Jeremy Martin
[5 minutes] Breakout Room Logistics, IEEE Vice Chair, Boston Section, Denise Griffin
[20 minutes+] OPTIONAL - Breakout Rooms and Networking - All Presenters, Connor Archard
[5 minutes] Closing Remarks, adjourn

Registration:
Please register in advance on Vtools:
https://events.vtools.ieee.org/m/261229

Dr. Sobers holds an PhD in Electrical Engineering from the University of Massachusetts Amherst and has worked at MITRE since her first internship in 2007. She supports a variety of projects across the MITRE National Security Federally Funded Research and Development Center (FFRDC) and leads a group in the MITRE Communications, Signals Intelligence, and PNT department.

Wayne McLaggan has a Master of Engineering in Electrical engineering from the Air Force Institute of Technology and has worked at MITRE since 2013. Wayne leads the Signals Processing group for the Army Intelligence and Sensors department and helps to lead the Photon development effort in support of our Department of Defense sponsors.

Jeremy Martin has a Master of Science in Computer Science from Johns Hopkins University and has worked at MITRE since 2014. Jeremy is a project and technical leader at MITRE and defines the architecture and drives the agile workflow for large projects in MITRE's Army Intelligence and Sensors department.

IEEE Boston Reliability, NE ESDA Chapter, and iMAPS New England – 6:00PM, Wednesday, March 10

ESD Fixture Design Considerations and Case Studies

Join us for this highly interactive webinar and learn about the complexity, customization and attention to detail required to successfully develop fixtures for ESD sensitive applications including Class 0 devices.

Fixture design considerations will be presented including material selection, ESD event detection, isolated conductors, and limitations of ionization.
Manufacturing applications will cover operations such as in-circuit test, ESD damage during a board connector press operation, cable discharges at test sets, automated test heads, and burn-in.

One of the Class 0 Case documents 22% failures rates with a good S20.20 program in place. The corrective action required modification to a test fixture and the addition of a special operating procedure.

A particularly interesting Class 0 case study will be presented on the installation of CCDs at the Gemini Observatory in Hawaii. These CCDs cost $175,000 each which did not have any input protection and a 10 V CDM sensitivity.

Location: This Webinar will be delivered through WebEx. Ensure your device has WebEx installed in advance.
At registration you must provide a valid e-mail address to receive the Webinar Session link the day before the event.
Ensure your e-mail settings allow messages from IEEE Boston MD to be delivered to your inbox.

CONTACT: Email event contact: NE-ESDA Planning
REGISTRATION: HTTPS://EVENTS.VTOOLS.IEEE.ORG/EVENT/REGISTER/263216

Speaker:
Ted Dangelmayer of Dangelmayer Associates, LLC
Ted is the president of Dangelmayer Associates, LLC and has assembled an ESD consulting team consisting of the foremost authorities in virtually all ESD areas of both product design and manufacturing.

He received the “Outstanding Contribution” award and the EOS/ESD Association, Inc. “Founders” award. He was president of EOS/ESD Association, Inc., chairman of the ESDA standards committee, and general chairman of the EOS/ESD Symposium. He has published two editions of his book, ESD Program Management, numerous magazine articles, and technical papers.

Ted holds three patents and is iNARTE certified. He is currently president of the Northeast local chapter of EOS/ESD Association, Inc., a member of the ESDA education Council, and Nominations Committee.
Email: ted@dangelmayer.com

Nuclear and Plasma Science Society (NPSS), Society of Social Implications and Technology (SSIT), IEEE HKN – Kappa Sigma Chapter, Education Society and Signal Process Society – 6:00PM, Thursday, March 11

Developing New Technology for Affordable Internet

Location: Webinar

Point of Contact: Professor Min-Chang Lee, Boston University
Where: Zoom Meeting: https://bostonu.zoom.us/j/97752789432?pwd=cndyb1ViRVByY2U5ajFhMzF-zcmlYQT09

Abstract: Starry is developing and deploying new technology with the goal of connecting billions of people worldwide to affordable, high speed internet. Currently, Starry's internet service is available in 5 different U.S. cities: Boston, LA, DC, Denver, and NYC. This mission is enabled by Starry's advanced multipoint system, which will be reviewed in this talk at a high level. Following the system overview, there will be a general technical discussion of applicable topics including path loss, link budget analysis, and digital predistortion. The session will conclude with questions.

Speaker:
Ryan Lagoy currently works at Starry, Inc. as the Communications Product Delivery Group Lead, developing and integrating new technology for internet applications. He previously worked at BAE Systems, in the Engineering Leadership Development Program. His interests and experience include systems engineering, RF/Microwave system design, electromagnetic theory and modeling, digital signal processing, and software development.

Entrepreneur's Network – 7:00PM, Tuesday, March 16

How to Use Strategic Alliances to Build Your Company

Location: ONLINE WEBINAR

Registration: Will be available soon. https://boston-enet.org/event-3892681

Look online for the full meeting decsription

Agenda:
5:30 – 6:45 – Networking on Grapevine Network
7:00 - 7:10 PM - ENET Chairperson's announcements
7:10 - 7:25 PM – eMinute Pitch - Up to 3 Startup companies' presentations
7:25 - 8:10 PM - expert speakers on the night's topic
8:10 - 8:30 PM – Moderator and Audience Q & A with the speakers
8:30 – 9:00 PM - Networking on Grapevine Network
(all times are USA Eastern Daylight time)

A question and answer session will follow the panel discussion, and panelists will be available afterward for responses to individual questions.

Photonics Society – 7:00PM Thursday, March 11

Ultraviolet Optoelectronics for a Better Living

Prof. Zetian Mi, University of Michigan, Ann Arbor, MI

Location: Webinar

Infectious diseases and water are some of the greatest, most urgent challenges of the 21st century. III-nitride ultraviolet (UV) light sources, including light emitting diodes (LEDs) and lasers, are the only alternative technology to replace conventional power-hungry, hazardous mercury lamps for disinfection and water purification. Recent studies showed that AlGaN-based UV-C LEDs can readily shred genetic material of viruses and bacterial and achieve 99.9% sterilization of SARS-COV-2.

In this talk, I will present the recent advances of AlGaN and BN nanostructures and heterostructures and their applications in UV optoelectronics, including the first demonstration of mid and deep UV laser diodes and tunnel junction UV-C LEDs with significantly improved performance. The recent development of far-UV-C LEDs, in the wavelength range of 207-222 nm, will also be presented, which has shown to be faster and far more effective than traditional UV-C light (~265 nm) in preventing the transmission of microbial diseases, while causing virtually no harm to mammalian skin or eye.

Speaker:
Zetian Mi is a Professor in the Department of Electrical Engineering and Computer Science at the University of Michigan, Ann Arbor. He received the PhD degree in Applied Physics at the University of Michigan in 2006. His teaching and research interests are in the areas of III-nitride semiconductors, LEDs, lasers, quantum photonics, solar fuels, and artificial photosynthesis. Prof. Mi has edited 2 books and published 12 book chapters, 25 patents/patent applications, more than 200 journal papers, and over 300 conference papers/presentations on these topics. He was a faculty member at McGill University from 2007 to 2016, where he received several awards, including the Hydro-Québec Nano-Engineering Scholar Award in 2009, the William Dawson Scholar Award in 2011, the Christophe Pierre Award for Research Excellence in 2012, and the Engineering Innovation Award in 2105. Prof. Mi has received the Young Investigator Award from the 27th North American Molecular Beam Epitaxy (MBE) Conference in 2010, the Young Scientist Award from the International Symposium on Compound Semiconductors in 2015, and the IEEE Photonics Society Distinguished Lecturer Award in 2020. Prof. Mi currently serves as the Editor of Progress in Quantum Electronics and Serial Editor of Semiconductors and Semimetals. He also served as the Associate Editor of IEEE J. Lightwave Technol. as well as the Chair of many international conferences, including the General Chair of IEEE Photonics Conference in 2020, Program Chair of IEEE Photonics Conference in 2019, General Chair of IEEE Photonics Society Summer Topicals Meeting in 2016-2017, and Co-Chair of International Symposium on Semiconductor Light Emitting Devices in 2017. Prof. Mi is a fellow of SPIE and OSA. Prof. Mi is a co-founder and member of Board of Directors of NS Nanotech, Inc.

This meeting begins at 7 PM Thursday, March 11th, 2021 and will be online only.

The registration link will be posted two days prior to the seminar.

After registering, you will receive a confirmation email containing information about joining the webinar. This webinar will take place on Zoom and will be started 15 minutes early (at 6:45 EDT) to allow for technical troubleshooting. The seminar will begin at 7:00PM. For more information contact Keisuke Kojima, IEEE Boston Photonics Society chair at keisukekojima@ieee.org, or visit the IEEE Boston Photonics Society website at www.bostonphotonics.org.

Location: Online Seminar

Microwave Theory & Techniques Society – 6:30PM, Tuesday, March 16

Microwave Photonics Technology: Capabilities it Enables & Techniques to Optimize Performance

Speaker: Dr. Edward Ackerman

You're invited to a zoom webinar. Please click the link below to join the webinar: https://mit.zoom.us/j/91560580330

Both the scientific and the defense communities wish to receive and process information occupying ever-wider portions of the electromagnetic spectrum. This can often create an analog-to-digital conversion "bottleneck". Analog photonic channelization, linearization, and frequency conversion systems can be designed to alleviate this bottleneck. Moreover, the low loss and dispersion of optical fiber and integrated optical waveguides enable most of the components in a broadband sensing or communication system, including all of the analog-to-digital and digital processing hardware, to be situated many feet or even miles from the antennas or other sensors with almost no performance penalty. The anticipated presentation will highlight the advantages and other features of analog photonic systems (including some specific systems that the author has constructed and tested for the US Department of Defense), and will review and explain multiple techniques for optimizing their performance.

Speaker:
Edward I. Ackerman received his B.S. degree in electrical engineering from Lafayette College in 1987 and his M.S. and Ph.D. degrees in electrical engineering from Drexel University in 1989 and 1994, respectively. From 1989 through 1994 he was employed as a microwave photonics engineer at Martin Marietta¹s Electronics Laboratory in Syracuse, New York, where he used low-loss narrowband impedance matching techniques to demonstrate the first amplifierless direct modulation analog optical link with RF gain (+3.7 dB at 900 MHz). From 1995 to July 1999 he was a member of the Technical Staff at MIT Lincoln Laboratory, where he developed high-performance analog photonic links for microwave communications and antenna remoting applications. During this time he achieved the lowest noise figure ever demonstrated for an amplifierless analog optical link (2.5 dB at 130 MHz). While at Lincoln Laboratory he also developed and patented a novel linearization technique that uses a standard lithium niobate modulator with only one electrode to enable improved analog optical link dynamic range across broad bandwidths and at higher frequencies than other linearization techniques currently allow. Since 1999 he has been Vice President of R & D for Photonic Systems, Inc. of Billerica, Massachusetts. He has co-edited a book and has authored or co-authored three book chapters as well as more than 70 technical papers on the subject of analog photonic subsystem performance modeling and optimization. Dr. Ackerman is a Fellow of the IEEE. He holds eight US patents.

Registration:
https://events.vtools.ieee.org/m/262088

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Facebook: https://www.facebook.com/IEEEBoston
YouTube: https://www.youtube.com/user/IEEEBostonSection
LinkedIn: https://www.linkedin.com/groups/IEEE-Boston-Section-3763694/about

Education Society and Signal Processing Society – 1:00PM, Wednesday, March 24

IEEE BTS Webcast: Classification of Audio Quality Using Machine Learning and Artificial Intelligence

Speaker: Tyler Morris, Tufts Graduate School of Electrical Engineering, Undergraduate WPI Electrical and Computer Engineering

Registration: https://bts.ieee.org/educational-programs/webinars-and-podcasts.html

The field of Audio Engineering has long relied on finely tuned ears of experts to accomplish the task of determining proper microphone location, thus maximizing audio quality. As home studio applications become increasingly popular, the need for a consumer solution is more apparent than ever. Meanwhile, the fields of Machine Learning and Artificial Intelligence have in recent years been responsible for tackling many diverse problems that were previously thought to be near impossible. With a recent worldwide pandemic increasing the demand for quality home audio applications, the authors of this paper have decided to investigate audio quality and determine if it is possible for non-human ears to classify and quantify an audio recording's sound as "good" or "bad". While Machine Learning and Artificial Intelligence have been used before in some audio applications, they have never been used in the manner that the author is proposing, which is to quantify audio recording quality. In this paper, the authors will discuss similar research that has been conducted, recall their development of a unique approach to solve the problem, analyze experiments that were performed in order to extract features from collected data, compare and contrast multiple methods of classifying test data and, finally, discuss future applications of this research that extend to many fields.

Tyler Morris, Tufts Graduate School of Electrical Engineering, Undergraduate WPI Electrical and Computer Engineering.

Tyler Morris is a 22-year-old Engineer from Boston, Massachusetts who is currently completing his Masters of Electrics Engineering at Tufts Graduate School in Spring 2021 and received his Bachelor's Degree in Electrical and Computer Engineering from WPI. At Tufts, Morris has been working closely with Dean Dr. Panetta to combine the field of Machine Learning with Morris' passion, Audio Engineering.

Morris has designed audio effects for the likes of Joe Bonamassa, Conan O'Brien, Brad Whitford (Aerosmith), Elliot Easton (The Cars), Brian May (Queen), Warren Haynes and others. Tyler Morris Designs (TMD) just released their consumer line of pedals with press releases from Premier Guitar, Guitar World and Music Radar. Also a notable musician, Morris has performed with music industry notables including Sammy Hagar, Steve Vai, Walter Trout, Christone "Kingfish" Ingram, Ronnie Earl, Yngwie Malmsteen, Leslie West, Robben Ford, Ronnie Montrose and many others. Morris is an endorsed artist by Gibson Guitars, Marshall Amps, Fishman and many other companies, aiding them in promotion and design of new innovative musical products.

Lastly, Tyler Morris has released four internationally acclaimed albums, with the most recent, "Living in The Shadows", debuting at #3 on the Billboard and iTunes Blues Charts. His passion for Engineering, music and audio has allowed him to succeed in numerous innovations developed from his unique drive and passion.

Symmetric Synchronous Electric Machine Alternative To Rare-Earth Permanent Magnet Electric Machines

Frederick W. Klatt
Chief Technology Officer
Best Electric Machine
Bedford, Ma, USA
Fred.klatt@bestelectricmachine.com

***Abstract*—The *symmetric synchronous electric machine circuit and control architecture* doubles the power density, halves the cost, and halves the loss (*per unit of power rating*) of the RE-PM electric machine system with the same performance enhancing material, winding, packaging, manufacturing, and thermal management techniques but with the precious rare-earth permanent magnet materials eliminated for their full deployment to other more strategic applications.**

I. SYNCHRO-SYM: Bottom Line Up Front

Electric motor and generator systems are the backbone of the electricity infrastructure. For instance, *electric motors* consume at least 45% of the entire global supply of electricity, which has a compounded annual growth of 4%, *electric generators* produce virtually the entire global supply of electricity, which includes electricity generated from renewable energy, and together, *electric motors and generator systems* (*or electric machine systems*) will produce and consume virtually the entire 70% of additional expected growth in the global supply of electricity for serving electric propulsion as the customary means of transportation by circa 2035. Electric machine systems are *fundamental* for renewable energy (*e.g., wind, hydro, tidal, hydrogen, etc.*), electric transportation (*e.g., ships, electric vehicles, electric airplanes, trains, etc.*), and industrial efficiency and automation (*e.g., fans, pumps, robots, machinery, etc.*).

Without argument, continuous improvement of the electric machine system provides enormous opportunities for the efficiency, cost, and power density of our energy infrastructure and future but with the shared belief that any electric machine circuit and control architecture that could be invented has been invented, electric machine system research and development (**R+D**) is focused on the strategic application of readily available and conveniently appliable performance enhancing material, winding, packaging, manufacturing, and thermal management techniques to *the century old electric machine circuit and control architecture with the asymmetry of a "passive rotor assembly" of permanent magnets, slip-induction dependent windings, reluctance saliencies, or direct current (DC) field windings*.

Notionally considered to be the most efficient and best performing without considering the extravagant cost, the potential to demagnetize with fading operating life, and the safety and manufacturing issues of *neodymium-dysprosium* rare-earth permanent magnets (**RE-PM**), the majority of R+D is blindly focused on the RE-PM electric machine system with its rapid application in electric transportation and wind turbines but with its supply chain controlled by a global adversary, a nation with its main goal of world domination, with disregard of environmental, human labor, free enterprise innovation, and geopolitical consequences. Instead, a *symmetric synchronous electric machine circuit and control architecture*, called SYNCHRO-SYM, doubles the power density, halves the cost, and halves the loss (*per unit of power rating*) of any RE-PM electric machine system with the same performance enhancing material, winding, packaging, manufacturing, and thermal management techniques but with the precious rare-earth permanent magnet materials eliminated for their full deployment to other more strategic applications.

II. SYNCHRO-SYM: Verification Basis

SYNCHRO-SYM has been performance verified by lengthy analytical analysis, by several progressive stages of prototyping, including pre-production prototyping, and more importantly, by a customized computer aided design tool (BEM-CAD) that simultaneously provides side-by-side comparisons with the RE-PM and Induction electric machine systems, all of which are designed to the same electrical parameters with the same winding, material, packaging, thermal management, and control techniques for absolute fairness.

With superconductor electric machine system as the exception, the *basic electric machine design axioms* from Appendix I reasonably show all *optimally designed* electric machine systems with similarly applied performance enhancing material, winding, packaging, manufacturing, thermal, and control techniques will have similar air-gap flux density by design, which in accordance with the basic design relationships of Faraday's Law, Lorentz Force Law, Ampere Circuital Law, and the Synchronous Speed Relation under the same voltage and frequency of excitation, pole-pair count, and thermal considerations, will have a similar active winding set with similar continuously rated "synchronous speed" torque and effective air-gap area that reasonably assumes similar overall electric machine size and volume, particularly in an axial flux format. Therefore, the true cost-performance differentiators between *equally design optimized* electric machine systems, including RE-PM electric machine systems, must be: 1) the continuous constant-torque speed range (*at a given synchronous speed design torque*) and for a given voltage and frequency of

excitation, 2) the associated overall loss or efficiency per unit of power, and 3) the peak torque and peak power capabilities, all of which go beyond the century old, singly-fed or doubly-fed electric machine system circuit and control architecture with a passive rotor of *slip-induction dependent* multiphase windings, reluctance saliencies, DC field windings, or RE-PMs.

In addition to the basic design axioms, all electric machine systems should be grouped into just two categories of circuit and control architectures for convenient comparison purposes: 1) the *century old* asymmetric electric machine system circuit and control architecture, which comprises: a) the *associated loss, cost, and size* of a "active stator" assembly with an active winding set to establish the continuous torque and power rating, b) the similar *associated loss, cost, and size* of a "passive rotor assembly" with the asymmetry of a *slip-induction dependent* multiphase winding set (*i.e., asynchronous electric machine*), reluctance saliency set (*i.e., synchronous or asynchronous reluctance electric machine*), or a DC field winding (e.g., electromagnet) or RE-PMs (*i.e., traditional synchronous electric machine*) to establish the airgap magnetic field without contributing additional active power (*i.e., work*) to the electromechanical conversion process, and c) the derivative of field oriented excitation controller (**FOC**) to establish the speed-synchronized excitation by the delays and estimations of offline (*i.e.., electronic*) measurement and processing that always introduce unstable components of slip-induction, or 2) the symmetric synchronous electric machine system circuit and control architecture (*or the brushless, symmetric multiphase wound-rotor [synchronous] doubly-fed electric machine system*), called SYNCHRO-SYM, which instead of the "passive rotor" assembly and FOC of the asymmetric electric machine system, comprises an "active rotor" assembly with another stator similar active winding set (*that also inherently provides the sought after efficiency of a copper wound rotor*) that in conjunction with the active stator winding set, synchronously contributes *additional* working power to the electromechanical conversion process as only possible by a brushless, *bi-directional,* instantaneous (*i.e., real time*) and sensor-less and automatic (*i.e., emulation*) excitation controller (*i.e., brushless real time emulation controller or* ***BRTEC***) to establish speed (and phase) synchronized excitation with the unique ability of eliminating unstable reliance on slip-induction between sub-synchronous to super-synchronous speeds and with automatic and instantaneous response to any rotor or line perturbations, particularly at or about synchronous speed where slip-induction is vague or ceases to exist.

- BRTEC is akin to the "electromechanical commutator" of the high peak torque and peak power Universal Motor that automatically and instantaneously provides a speed-synchronized, "single phase," choppy, and low resolution excitation waveform to the rotor active multiphase winding set (i.e., armature) by a speed-synchronized rotating set of mechanical switches, BRTEC of the ultra-higher peak torque and peak power SYNCHRO-SYM *brushlessly*, automatically, and instantaneously provides speed-synchronized "multiphase," pure sinusoidal, and high resolution waveforms to the rotor active winding set by direct high speed AC-to-AC electronic conditioning with an electromagnetic computer.

III. SYNCHRO-SYM: Empirical Observation

In concert with the basic electric machine design axioms applied to the electric machine system grouping, the following *simple straight-forward empirical observation will verify the performance* between SYNCHRO-SYM with all asymmetric electric machine system architectures, which is without the usual lengthy analytical analysis that is already available from many sources with some modification, such as BRTEC, for symmetric synchronous doubly-fed operation [1]:

- Only SYNCHRO-SYM *twice magnifies the constant-torque speed range for a given pole-pair count, continuous torque, frequency and voltage of excitation, and packaging* by stably operating from sub-synchronous, such as zero speed, to super-synchronous, such as at synchronous speed or twice synchronous speed, which is tantamount to twice the core power density at half the cost and loss per unit of power rating of the asymmetric electric machine system:
  - e.g., 7200 RPM for SYNCHRO-SYM with 2 poles and 60 Hz excitation (*with the sum of the rotor excitation frequency and stator excitation frequency in accordance with the Synchronous Speed Relation*) versus 3600 RPM for the asymmetric electric machine system (*with the rotor frequency close to zero in accordance with the Synchronous Speed Relation*).
- Only SYNCHRO-SYM *twice magnifies the power density while halving the cost and loss (per unit of active power)* by replacing the "passive" rotor assembly of the asymmetric electric machine system with an "active" rotor assembly, which provides similar additional active power in concert with the active stator assembly, all within the same electric machine packaging of loss, cost, size, materials (*less RE-PM*), and windings:
  - By effectively eliminating the entire "passive rotor assembly" of slip-induction windings, DC field windings, reluctance saliencies, or RE-PMs, where reasonably half of the cost, size, and loss per unit of active power rating occur but without contributing additional active power to the electromechanical conversion process.
  - By establishing the air-gap magnetic field with half of the magnetizing MMF I^2R loss of the slip-induction electric machine system by sharing across the airgap.
  - Particularly by considering an asymmetric slip-induction electric machine system or an axial-flux form of asymmetric electric machine system (*i.e., adjacent rotor and stator disks of equal size*), such as the 3D printed amorphous axial flux electric machine by MOTORPRINTER.
- Only SYNCHRO-SYM *twice magnifies the performance improvement (per unit of active power) of performance enhancing material, winding, packaging, thermal, manufacturing, and control techniques*, which all

asymmetric electric machine systems are compelled to use for performance enhancement or so-called invention, *by the power of two active winding sets*.

- Only SYNCHRO-SYM *provides up to octuple the peak torque (per unit of active power)* of the asymmetric electric machine system by uniquely balancing the flux on each side of the airgap in accordance with the conservation of energy physics of a dual-ported transformer circuit topology (*i.e., the symmetry of an active winding set on the rotor and stator, respectively, as only provided by BRTEC*), which avoids reaching core saturation by holding airgap flux density and port voltage constant with increasing torque current (and resulting torque):
  - High peak torque potential is essential for eliminating the compounding size, loss, cost, maintenance, and reliability issues of the customary electric vehicle gearbox.
- Only SYNCHRO-SYM designs the steady state air-gap flux density closer to the saturation limits of electrical steel cores for another level of power density and efficiency by uniquely holding air-gap flux density constant, which is impractical with the unbalanced physics of the asymmetric RE-PM electric machine systems.
- Only SYNCHRO-SYM inherently provides comprehensively adjustable leading, lagging, or unity power factor correction for distributed dynamic volt-amp-reactive (VAR) compensation at the electric machine installation.
- Only SYNCHRO-SYM saves precious RE-PM materials for more strategic applications by replacing a major consumer, the RE-PM electric machine system, with a higher performing, more reliable, lower cost, and environmentally friendlier RE-PM free electric machine system alternative.
- Only SYNCHRO-SYM provides comparable superconductor electric machine system performance without the complexity of cryogenic superconductors, high flux density, and passive or active shielding by providing twice the power density and half the loss and cost of the RE-PM electric machine system.
- Only SYNCHRO-SYM brings superconductor electric machine systems of today closer to practical reality by a BRTEC that conveniently and brushlessly relocates the superconductor winding, cryogenics, and active or passive shielding provisioning to the stator side for improved superconductor logistics, while eliminating electronic control harmonic heating the pure sinusoidal excitation.
- Only SYNCHRO-SYM will be the electric machine system of choice by far surpassing the performance of the fully electromagnetic superconductor slip-induction asymmetric electric machine system with the expected availability of AC superconductors (by aggressive on-going research), which will be far superior to the RE-PM asymmetric electric machine system.
- Only SYNCHRO-SYM conveniently leverages the full performance opportunities expected from wide bandgap (WBG) semiconductors, such as high temperature tolerant Silicon Carbide (SiC) semiconductors, which are driving the next electric machine system evolution of completely integrating the motor and drive (IMD), as recently revealed in Combining Motors and Drives, Incredible Shrinking Motor Drive and Performance Comparison of State-of-Art 300A/1700V Si IGBT and SiC Power Modules, with a brushless solid-state high frequency electronic transformer and real time *emulation* electromagnet computer (BRTEC) that is inherently paired to the symmetric synchronous electric machine entity; instead of today's afterthought of adapting and integrating distinctly different circuit and control components, such as the FOC with the asymmetric electric machine entity.
- Only SYNCHRO-SYM integrates BRTEC in the empty annulus space of an axial-flux formfactor to provide another level of higher power density and the symmetry of duplicate rotor and stator assemblies for fewer parts inventory and shipping.
- Only SYNCHRO-SYM allows scalable componentization for small, low weight shippable rotor and stator components with easy and safe field assembly by eliminating the safety, manufacturing, and assembly complications of RE-PMs.

IV. SYNCHRO-SYM: Conclusion

With the majority of the so-called Rare Earth (RE) material supply chain owned and controlled by a formidable global adversary, a nation with its main goal of world domination, with disregard of environmental, human rights, free enterprise innovation and geopolitical consequences, it is essential to seek an alternative solution to the RE-PM electric motor or generator system for the efficiency, cost, and power density of our energy future, which again is being rapidly applied in the electric transportation and wind turbines by its *notional* efficiency and performance attributes.

As the only symmetric synchronous electric machine system circuit and control architecture, SYNCHRO-SYM provides the only practical cost-performance solution to the RE-PM electric machine system with twice the power density at half the loss and cost per unit of power rating in the same package of materials (less RE-PMs), winding, and thermal management techniques, while also leaving the precious RE-PM materials available for other strategic applications. Like all electric machine systems, SYNCHRO-SYM does comprise copper (windings) and electrical steel (*e.g., fully electromagnetic core*) with their material demand expected to rise dramatically by embracing green electric technology but unlike RE materials, copper and steel are abundantly available without cartel control. More importantly, simple quantitative observation shows that only SYNCHRO-SYM effectively halves the amount of these materials per unit of electric machine power rating and when AC superconductors become a practical reality, copper and steel will again be reduced, if not eliminated, which will elevate the *fully electromagnetic* SYNCHRO-SYM as the electric machine system of choice without rival.

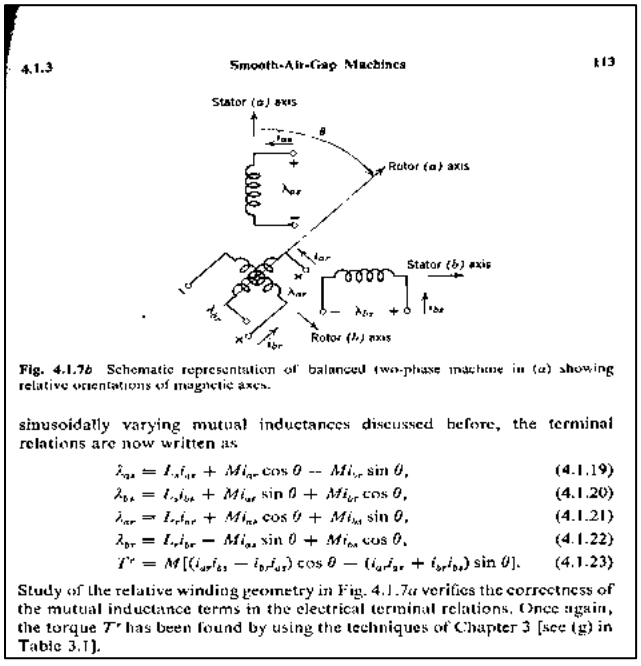
SYNCHRO-SYM: APPENDIX I

Some *basic electric machine design axioms* from Electric Machine Design Distinctions and Constraints will follow:

- All linear or rotating magnetic electric motors and generators (*i.e., electric machines*) produce moving force (or rotating torque) by the synchronized interaction between two orthogonal magnetic flux or current vector components on the rotor and stator bodies, respectively, that pull or push on each other:
  - The two orthogonal vectors are: 1) winding *magnetizing MMF* or *magnetizing flux* (*or permanent magnet coercivity*) for "passively" establishing the flux density in the air-gap between the rotating and stationary bodies (*i.e., static energy*) and 2) winding *torque MMF* or *torque flux* for "actively" establishing force at speed to produce kinetic energy (*or work*). (*Note: Magneto-Motive-Force (**MMF**) is the product of winding turns and current*).
  - Only a multiphase winding set that is "directly" excited at its terminals (*or active winding set*) produces a rotating (or moving) magnetic field in relation to its frame that independently contributes bi-directional active power to the electrical to mechanical (*i.e., electromechanical*) energy conversion process but only by satisfying the ***Synchronous Speed Relation*** for a given pole-pair count (*i.e., ± rotor winding excitation frequency ± stator winding excitation frequency ± angular mechanical speed is equal to zero with "synchronous speed" at zero rotor winding excitation frequency*).
- All electric machines must have at least one active winding set (*i.e., singly-fed*), which is generally on the stator for convenient provisioning, or at most two active winding sets (*i.e., doubly-fed*) before the basic electric machine circuit topology is replicated again (*Note: Traditionally, "doubly-fed" was anecdotal for any electric machine with two electrical power ports, one of which is without bi-directional or active power capability, such as a passive DC field winding port*):
  - The *torque rating* of any electric machine system is determined by a single active winding set (e.g., the stator active winding set) with torque proportional to the torque MMF of the active winding set; but the *power rating* of any electric machine system is determined by the sum of the designed power rating of all active winding sets or total power rating is proportional to the product of the port voltage and the sum of the torque MMF of the active winding sets or by the product of torque and constant-torque speed range in accordance to the synchronous speed relation.
- All electric machines are optimally designed with similar air-gap flux density because with the exception of superconductor electromagnets, the air-gap flux density, which is the sum of the two rotating magnetic field vectors, is determined by the same saturation limits and permeability of the electrical steel core and not by the residual flux density potential of rare-earth permanent magnets (**RE-PM**) or the boundless flux density potential of an electromagnet (*after all, it takes the high flux density of an electromagnet to magnetize a permanent magnet*):
  - Establishing the largest possible airgap flux density within the flux saturation limit of the electrical steel core is the first steady state design criteria for any electric machine.
  - RE-PMs cannot achieve the same air-gap flux density provided by an electromagnet because unlike the BH product curve of an electromagnet with flux density directly proportional to magnetizing MMF, the BH product curve of a RE-PM shows flux density is inversely proportional to PM coercivity with ever larger amounts (*or magnetic path thickness*) of expensive RE-PM materials to achieve the flux saturation limit of the electrical steel core at operating temperature (e.g., 1.25T at 100^0C).
  - RE-PMs are without electrical loss but are temperature sensitive, have potential to demagnetize with fading operating life, and have safety and manufacturing issues. In contrast, an electromagnet has variable flux density (*i.e., field weakening*) but are constrained by winding resistance and electrical loss.
  - RE-PMs eliminate electrical provisioning and electrical loss of winding magnetizing MMF; but ironically, magnetizing MMF is being *reintroduced* into RE-PM electric machines to regain the coveted attributes provided by field weakening (*with similar associated loss, cost, and size*).
  - Although RE-PMs are more compact (*i.e., shallower*) and lighter than an electromagnet when producing an air-gap flux density under approximately one Tesla at operating temperature, the necessary active winding set still determines the effective air-gap area and associated size and volume of any electric machine.
- All electric machines show similar torque, effective air-gap area and winding turns when the necessary "active winding set" is optimally designed under the same air-gap flux density in accordance to Lorentz Law and under the same voltage, speed, and excitation frequency in accordance to Faraday's Law with the *overall electric machine size and volume* directly proportional to the area of the effective air-gap with winding provisioning, such as slots, frame, and thermal management.
- All electric machines function as either: 1) a *slip-induction (or asynchronous) electric machine*, which depends on the slip (or asynchronism) between the speed of the rotating magnetic field of the excited stator active winding set and the speed of the rotor for current induction onto the rotor multiphase winding set (*in accordance to the Synchronous Speed Relation with the rotor excitation not equal to zero*) and as a result, a *slip-induction (or asynchronous) electric machine functionally relies* (or depends) on slip-induction between rotor and stator, 2) a *synchronous electric machine*, which traditionally depends on the phase-locked synchronism between the speed of the rotating magnetic field of the excited stator active winding set and the speed

of a rotor to avoid slip-induction onto a rotor of permanent magnets or DC electromagnets (*in accordance to the Synchronous Speed Relation with the rotor excitation frequency equal to zero*) but to provide a universally accurate definition that includes the hypothetical symmetric synchronous (*i.e., doubly-fed*) electric machine from the classic textbook study of Figure 1, a *synchronous electric machine* does not *functionally rely* (or depend) on slip-induction between the rotor and stator, and 3) a *synchronous (or asynchronous) reluctance electric machine* depends on the synchronous (or asynchronous) movement between the rotating magnetic field of the excited stator active winding set and the rotor core to provide a moving magnetizing MMF or flux vector by varying the permeability anomalies of the magnetic path with displacement.

- All electric machines are optimally designed by applying the same available material, thermal, winding, manufacturing, packaging, and control optimizing techniques to achieve higher power density, higher efficiency, and lower cost, which are continually being researched and improved as demonstrated by today's electric machine system power density and efficiency achievements.
- All electric machines of today provide high performance by electronically synchronizing the winding excitation frequency to the speed of the shaft in accordance with the Synchronous Speed Relation: 1) for practical operation, such as for a *functional* RE-PM or reluctance electric machine system, 2) for optimum application balancing, such as for variable speed or for torque and active power control, and 3) for higher operating speeds (*e.g., extended constant horsepower speed range*) and electronic reliability, such as by adjusting magnetizing MMF, commonly known as *field weakening*.
- All electric machines follow the classic textbook study that begins with the *symmetric* electromagnetic relationships of the *multiphase wound-rotor [synchronous] doubly-fed electric machine system* (see Figure 1) comprising the symmetry of two similar active winding sets on the rotor and stator, respectively, as only realized by postulating brushless, instantaneous, sensor-less, and automatic excitation to inherently guarantee steady-state stability for its simple study. The same symmetric electromagnetic relationships become the study of all other (or *asymmetric*) *electric machine systems* by deoptimizing the symmetrical relationships with the asymmetry of a stator body with an active winding set but a rotor body with a passive slip-induction dependent winding set, rotor saliency set, RE-PM set, or DC field winding set.
  - Although researched since at least the 1960s, a practical contiguously stable symmetric "synchronous" doubly-fed electric machine has never materialized, because of the formidable challenges of realizing the instrumental brushless real time emulation control means for eliminating the unstable "reliance or dependency" on slip-induction excitation and to instantaneously and automatically respond to rotor and line perturbations. Coupled with the common belief that everything that can be invented has been invented, electric machine research was conveniently redirected to the century old asymmetric electric machine circuit and control architecture, in particular to the RE-PM electric machine system by strategically applying performance enhancing material, control, and packaging techniques.
  - Not to be confused with the symmetric synchronous electric machine system, the so-called slip-induction (or asynchronous) or slip-energy recovery doubly-fed electric machine system is just another example of an asymmetric electric machine system with the known instability issues of slip-induction dependency, particularly about synchronous speed where slip-induction ceases to exist.



4.1.3 Smooth-Air-Gap Machines 113

Stator (a) axis

Rotor (a) axis

Stator (b) axis

Rotor (b) axis

Fig. 4.1.7*b* Schematic representation of balanced two-phase machine in (a) showing relative orientations of magnetic axes.

sinusoidally varying mutual inductances discussed before, the terminal relations are now written as

$$\lambda_{as} = L_s i_{as} + M i_{ar} \cos\theta - M i_{br} \sin\theta, \quad (4.1.19)$$
$$\lambda_{bs} = L_s i_{bs} + M i_{ar} \sin\theta + M i_{br} \cos\theta, \quad (4.1.20)$$
$$\lambda_{ar} = L_r i_{ar} + M i_{as} \cos\theta + M i_{bs} \sin\theta, \quad (4.1.21)$$
$$\lambda_{br} = L_r i_{br} - M i_{as} \sin\theta + M i_{bs} \cos\theta, \quad (4.1.22)$$
$$T^e = M[(i_{ar} i_{bs} - i_{br} i_{as}) \cos\theta - (i_{ar} i_{as} + i_{br} i_{bs}) \sin\theta]. \quad (4.1.23)$$

Study of the relative winding geometry in Fig. 4.1.7*a* verifies the correctness of the mutual inductance terms in the electrical terminal relations. Once again, the torque T^e has been found by using the techniques of Chapter 3 [see (g) in Table 3.1].

Figure 1

Taken from Herbert H. Woodson and James R. Melcher, "Electromechanical Dynamics, Part 1: Discrete Systems," page 113, John Wiley & Sons, 1968, Figure 1 demonstrates the classic textbook study for all electric machines begins with the symmetrical mathematical relationships (i.e., 4.1.19, 4.1.20, 4.1.21, 4.1.22, and 4.1.23) describing the synchronized moving magnetic fields of a symmetrical multiphase wound-rotor doubly-fed electric machine with two phase winding sets on the rotor and stator, respectively, and the hypothetical application of brushless and bi-directional speed synchronized power at the winding terminals.

REFERENCES

[1] V. Seshadri Sravan Kumar, D. Thukaram,"Alternate Proof For Steady State Equivalent Circuit of a Doubly Fed Induction Machine," IEEE Transaction on Power Electronics, January 23, 2015

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Speaker Bios:

Greg Caswell, a Lead Consulting Engineer for Ansys Corporation, is an industry recognized expert in the fields of SMT, advanced packaging, printed board fabrication, circuit card assembly, and bonding solutions using nanotechnology. He has been well-regarded as a leader in the electronics contract

manufacturing and component packaging industries for the past 50 years. He has presented over 270 papers at conferences all over the world and has taught courses at IMAPS, SMTA and IPC events. He helped design the 1st pick and place system used exclusively for SMT in 1978, edited and co-authored the 1st book on SMT in 1984 for ISHM and built the 1st SMT electronics launched into space. Be on the lookout for his new book entitled Design for Excellence in Electronics Manufacturing due out in September 2020. Greg has won several awards including the IMAPS Lifetime Achievement Award in 2018, the ISHM Daniel C. Hughes Award (highest award given to an individual), ISHM Fellow of the Society Award and the Tracor Technical Innovation Award.

Dock Brown brings his more than 30 years of electronics reliability experience to clients of Ansys. Prior to joining Ansys, he spent 20 years at Medtronic where he most recently concentrated on cross business unit implementation of reliability initiatives for Class III medical devices. He was also responsible for supplier assessment and approval, on-going supplier audits, failure analysis, corrective actions, MRB, sampling, and ultimately full accountability for quality and reliability of COTS and custom parts and assemblies from a worldwide supplier base. Earlier in his career, Mr. Brown also spent time at Sundstrand Data Control where he led the implementation of the Boeing AQS program and with Olin Aerospace.

As a volunteer, he has been involved with ASQ, IEEE, IPC, and SMTA. He was the keynote speaker at the SMTA Cleaning Conference. He has taught design for reliability, tin whiskers, statistics, design of experiments, and contributed to standards development. He has won the SMTA Distinguished Speaker award and the SMTA Microelectronics Conference Best Paper award.

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Introduction to Practical Neural Networks and Deep Learning (Part I)

Times and Dates : 9:00AM - 12:15PM, Saturday, March 20, 2021
(3 hours of instructions!)

Speaker: CL Kim

Last Notice Before Course Begins, Please Register Now!!!!

Location: A live, interactive webinar

Overview:

From the book introduction: “Neural networks and deep learning currently provides the best solutions to many problems in image recognition, speech recognition, and natural language processing.”

This Part 1 and the planned Part 2 (late spring/early summer 2021, to be confirmed) series of courses will teach many of the core concepts behind neural networks and deep learning.

Reference book:
“Neural Networks and Deep Learning” by Michael Nielsen, http://neuralnetworksanddeeplearning.com
More from the book introduction: “We’ll learn the core principles behind neural networks and deep learning by attacking a concrete problem: the problem of teaching a computer to recognize handwritten digits. ...it can be solved pretty well using a simple neural network, with just a few tens of lines of code, and no special libraries.” “But you don’t need to be a professional programmer.” The code provided is in Python, which even if you don’t program in Python, should be easy to understand with just a little effort.

Benefits of attending the series:

* Learn the core principles behind neural networks and deep learning.
* See a simple python program that solves a concrete problem: teaching a computer to recognize a handwritten digit.
* Improve the result through incorporating more and more of core ideas about neural networks and deep learning.
* Principle-oriented, with worked-out proofs of fundamental equations of backpropagation for those interested.
* Yet hands-on practical, with simple code examples.

Course Background and Content:

This is a live instructor-led introductory course on Neural Networks and Deep Learning. It is planned to be a two-part series of courses. The first course is complete by itself. It will be a pre-requisite for the planned second course. The class material is mostly from the highly-regarded and free online book “Neural Networks and Deep Learning” by Michael Nielsen, plus additional material such as some proofs of fundamental equations not provided in the book, and (in planned Part 2) touching on more recent neural network types such as ResNet.

Agenda

Introduction to Practical Neural Networks and Deep Learning (Part 1)
Feedforward Neural Networks.
* Simple (Python) Network to classify a handwritten digit
* Learning with Gradient Descent
* How the backpropagation algorithm works
* Improving the way neural networks learn:
** Cross-entropy cost function

** Softmax activation function and log-likelihood cost function
** Rectified Linear Unit
** Overfitting and Regularization:
*** L2 regularization
*** Dropout
*** Artificially expanding data set
*** Hyper-parameters

Introduction to Practical Neural Networks and Deep Learning (planned Part 2, to be confirmed)
Convolutional Neural Networks.
* Local receptive field, Feature map. * Pooling layer. * Simple (Python) Convolutional Neural Network to classify a handwritten digit. * Improving the network, Regularization. * Touch on more recent progress in image recognition, such as Residual Network (ResNet).

Pre-requisites:
There is some heavier mathematics in proving the four fundamental equations behind backprogation, so a basic familiarity with multivariable calculus and linear algebra is expected, but nothing advanced is required. (The backpropagation equations can be also just accepted without bothering with the proofs since the provided python code for the simple network just makes use of the equations.)

Speaker Background:
CL Kim works in Software Engineering at CarGurus, Inc. He has graduate degrees in Business Administration and in Computer and Information Science from the University of Pennsylvania. He has previously taught for a few years the well-rated IEEE Boston Section class on introduction to the Android platform and API.

Decision (Run/Cancel) Date for this Course is Monday, March 15

IEEE Members	**$110**
Non-members	**$130**

http://ieeeboston.org/event/neuralnetworks/?instance_id=2987

Call for Course Speakers/Organizers

IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity. The IEEE Boston Section, its dedicated volunteers, and over 8,500 members are committed to fulfilling this core purpose to the local technology community through chapter meetings, conferences, continuing education short courses, and professional and educational activities.

Twice each year a committee of local IEEE volunteers meet to consider course topics for its continuing education program. This committee is comprised of practicing engineers in various technical disciplines. In an effort to expand these course topics for our members and the local technical community at large, the committee is publicizing this CALL FOR COURSE SPEAKERS AND ORGANIZERS.

The Boston Section is one of the largest and most technically divers sections of the IEEE. We have over 20 active chapters and affinity groups.
If you have an expertise that you feel might be of interest to our members, please submit that to our online course proposal form on the section's website (www.ieeeboston.org) and click on the course proposal link (direct course proposal form link is **http://ieeeboston.org/course-proposals/** . Alternatively, you may contact the IEEE Boston Section office at ieeebostonsection@gmail.com or 781 245 5405.

- **Honoraria can be considered for course lecturers**
- Applications oriented, practical focused courses are best (all courses should help attendees expand their knowledge based and help them do their job better after completing a course
- Courses should be no more than 2 full days, or 18 hours for a multi-evening course
- Your course will be publicized to over 10,000 local engineers
- You will be providing a valuable service to your profession
- Previous lecturers include: Dr. Eli Brookner, Dr. Steven Best, Colin Brench, to name a few.

DSP for Wireless Communications

Times and Dates (for live Q&A sessions) : 7 - 8PM ET, Thursdays, May 20, 27, June 3, 10, 17

Videos Released weekly beginning on May 14, 2021 (2 @ 1.5 hours)

Speaker: Dan Boschen

Location: Webinar

New Format Combining Live Workshops with Pre-recorded Video - This is a hands-on course providing pre-recorded lectures that students can watch **on their own schedule** and an **unlimited number of times** prior to live Q&A/Workshop sessions with the instructor. Ten 1.5 hour videos released 2 per week while the course is in session will be available for up to two months after the conclusion of the course.

Course Summary

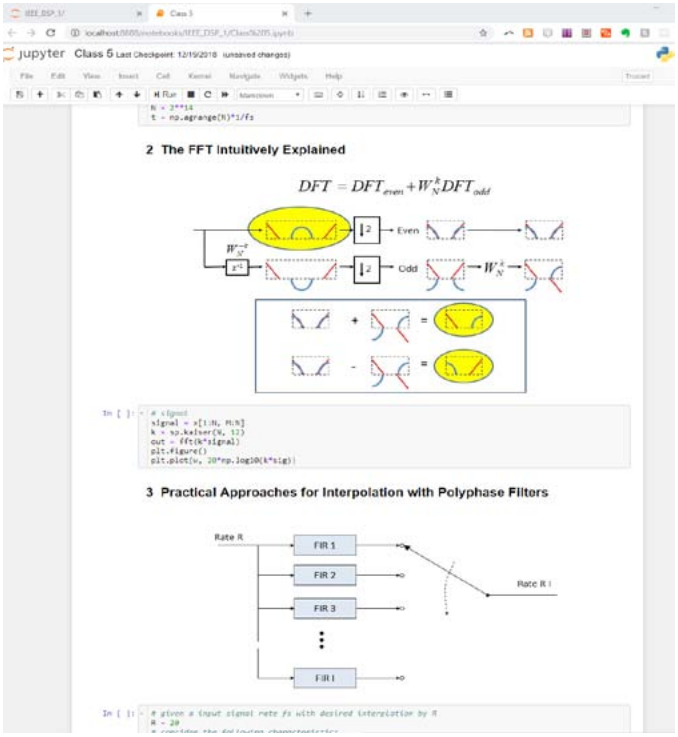
This course is a fresh view of the fundamental and practical concepts of digital signal processing applicable to the design of mixed signal design with A/D conversion, digital filters, operations with the FFT, and multi-rate signal processing. This course will build an intuitive understanding of the underlying mathematics through the use of graphics, visual demonstrations, and applications in GPS and mixed signal (analog/digital) modern transceivers. This course is applicable to DSP algorithm development with a focus on meeting practical hardware development challenges in both the analog and digital domains, and not a tutorial on working with specific DSP processor hardware.

Now with Jupyter Notebooks!

This long-running IEEE Course has been updated to include Jupyter Notebooks which incorporates graphics together with Python simulation code to provide a “take-it-with-you” interactive user experience. No knowledge of Python is required but the notebooks will provide a basic framework for proceeding with further signal processing development using that tools for those that have interest in doing so.

This course will not be teaching Python, but using it for demonstration. A more detailed course on Python itself is covered in a separate IEEE Course “Python Applications for Digital Design and Signal Processing”.

Students will be encouraged but not required to load all the Python tools needed, and all set-up information for installation will be provided prior to the start of class.

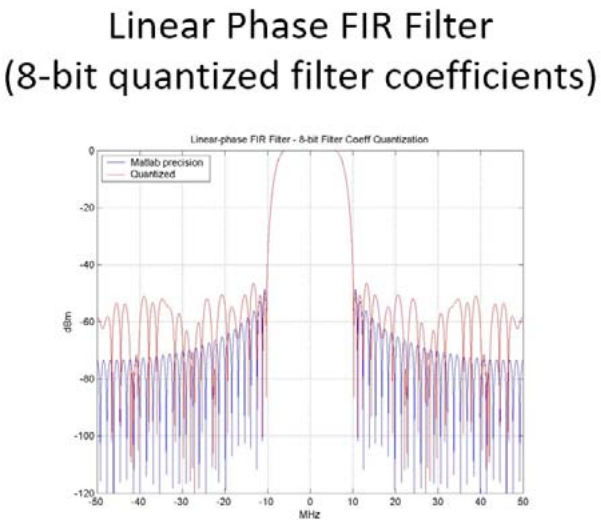


Target Audience:

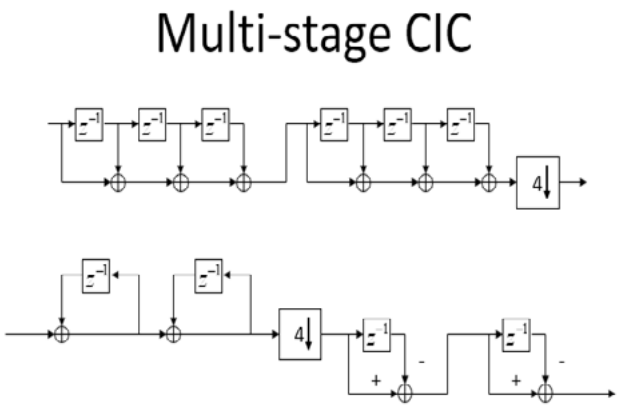
All engineers involved in or interested in signal processing applications. Engineers with significant experience with DSP will also appreciate this opportunity for an in-depth review of the fundamental DSP concepts from a different perspective than that given in a traditional introductory DSP course.

Benefits of Attending/ Goals of Course:

Attendees will build a stronger intuitive understanding of the fundamental signal processing concepts involved



with digital filtering and mixed signal analog and digital design. With this, attendees will be able to implement more creative and efficient signal processing architectures in both the analog and digital domains. The knowledge gained from this course will have immediate practical value for any work in the signal processing field.



Topics / Schedule:

Class 1: Correlation, Fourier Transform, Laplace Transform

Class 2: Sampling and A/D Conversion, Z –transform, D/A Conversion

Class 3: IIR and FIR Digital filters, Direct Fourier Transform

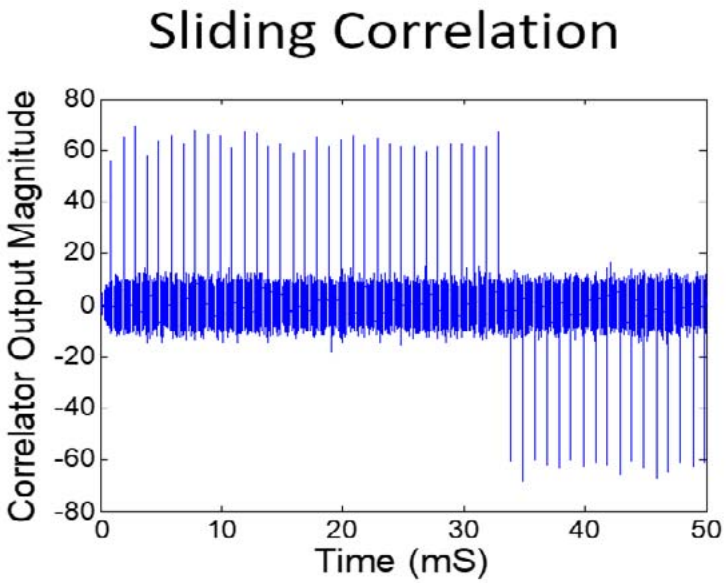
Class 4: Windowing, Digital Filter Design, Fixed Point vs Floating Point

Class 5: Fast Fourier Transform, Multi-rate Signal Processing, Multi-rate Filters

Speaker's Bio:

Dan Boschen has a MS in Communications and Signal Processing from Northeastern University, with over 25 years of experience in system and hardware design for radio transceivers and modems. He has held various positions at Signal Technologies, MITRE, Airvana and Hittite Microwave designing and developing transceiver hardware from baseband to antenna for wireless communications systems. Dan is currently at Microchip (formerly Microsemi and Symmetricom) leading design efforts for advanced frequency and time solutions.

For more background information, please view Dan's Linked-In page at: http://www.linkedin.com/in/dan-boschen



Decision (Run/Cancel) Date for this Course is Tuesday, May 11, 2021

IEEE Members	**$190**
Non-members	**$210**

http://ieeeboston.org/event/digital-signal-processing-webinar/?instance_id=3018

Modern Applications of RISC-V CPU Design

Access Period: **September 1 - 30, 2021 (originally scheduled for March '21)**

Speaker: **Steve Hoover, Redwood, EDA**

Type of Course: Self-paced, on-demand Course. Lab format

Course Overview: CPUs are a fundamental building block of complex SoCs, and RISC-V is taking hold as the ISA of choice. In this workshop, you will create a Verilog RISC-V CPU from scratch, and you will modify this CPU to be suitable for different applications.

You will learn and use modern techniques, using Transaction-Level Verilog to generate and modify your Verilog code more reliably, in far less time. You will discover how concepts like pipelining and hazards can be incorporated easily using timing-abstract design principles. All labs will be completed online in the Makerchip.com IDE for open-source circuit design. The skills you learn will be applicable far beyond CPU design.

Outline of Topics to be Covered:
Digital logic using TL-Verilog and Makerchip
– combinational logic
– sequential logic
– pipelined logic
– validity
– a calculator circuit
Basic RISC-V CPU microarchitecture
– single-cycle CPU microarchitecture
– testbench, test program, and lab setup for your CPU
– fetch, decode, and execute logic for RISC-V subset
– control flow logic
Pipelined RISC-V subset CPU microarchitecture
– simple pipelining of the CPU
– hazards and PC redirects
Completing the RISC-V CPU
– data memory and load/store
– remaining RISC-V (RV32I) instructions

Course Format:
– self paced, on demand course, providing attendees a flexible schedule
– access to content for 30 days
– pre-scheduled live Zoom and chat sessions with the instructors during the 30 day access period
– offline chat available with instructors during the entire 30 day access period (reply within 24 hours).

Target Audience: Engineers interested in a career in digital logic design or adjacent disciplines, including experienced engineers looking to modernize their skill set.

Prerequisites: An engineering education and basic understanding of digital logic. (Verilog knowledge is not a prerequisite.)

Benefits of Attending:
– Develop a solidified understanding of pipelined CPU design through hands-on labs.
– Acquire knowledge of advanced digital circuit design methodology.
– Gain exposure to an open-source design ecosystem.

Speaker Bio: Steve Hoover is the founder of Redwood EDA, an early-stage startup focused on advanced silicon design methodology and tools. Steve is a former logic design lead for DEC, Compaq, and Intel and has extensive experience designing high-performance server CPUs and network switches.

System Requirements: All resources are free and online; no download or installation required. We will use Slack, Zoom, GitHub Classroom, and Makerchip.com.

Decision (Run/Cancel) Date for this Course is Wednesday, August, 25, 2021

IEEE Members	**$350**
Non-members	**$395**

http://ieeeboston.org/event/modern-applications-of-risc-v-cpu-design-course/?instance_id=2955

Last Notice Before Course Begins, Please Register Now!!!!

Polar Codes - Encoding and Decoding Aspects

Web-based Course with live Instructor!

Times & Dates: 10AM ET, Tuesdays, March 2, 9, 16, 23, Thursdays, March 4, 11, 18, 25, 2021

Speaker: Orhan Gazi, Cankaya University, Ankara-Turkey

Course Format: Live Webinar, 8 one hour, sessions

Overview: Forward error correction is a vital process in communication systems. **The last channel codes discovered in the research world are the "polar codes" which are adapted to be used in 5G standard.** The construction and decoding of polar codes are quite different from the construction and decoding of classical channel nodes. Polar codes are the only codes constructed in a non-trivial manner. The discovery of polar codes can be considered as a breakthrough in coding society. It is clear that future channel codes will follow the logic of polar codes. For this reason, it is critical to learn the encoding and decoding philosophy of the polar codes which is the state of art of the coding world.

Outline of the topics to be covered:
- Entropy and Mutual Information
- Philosophy of Polar Codes
- Generator Matrices of Polar Codes
- Polar Encoder Structures
- Recursive Structures for Polar Encoders
- Channel Splitting and Concept of Channel Polarization
- Split Channels
- Calculation of Splitted Channel Capacities
- Polar Decoding
- Polar Decoding for Noiseless Transmission
- Polar Decoding Formulas for Kernel Structure for noisy Transmission
- Successive Cancelation Decoding of Polar Codes
- Polar Encoders and Decoders in 5G New Radio (NR) and Future Channel Codes

Target Audience: Electronic and Communication Engineers, electronic engineers, computer engineers, engineers working in communication industry

Benefits of Attending Course:
1) The participant will have an idea about the state of art polar codes.
2) Polar codes are used in 5G standard; the participant can comprehend the polar code used in 5G standard.
3) The participant will learn successive cancelation decoding of polar codes.

Speaker Bio: Prof. Orhan Gazi is the author of the book "Polar Codes. A Non-Trivial Approach to Channel Coding" which can be reached from https://www.springer.com/gp/book/9789811307362 The book is selected by IEEE COMSOC as one of the best readings in polar codes, https://www.comsoc.org/publications/best-readings/polar-coding

Prof. Orhan Gazi is the sole author of 10 books written in electrical engineering subjects. Apart from the polar code book, he is the single author of the books "Information Theory for Electrical Engineers" https://www.springer.com/gp/book/9789811084317 and "Forward Error Correction via Channel Coding" https://www.springer.com/gp/book/9783030333799. The research area of Prof. Orhan Gazi involves "channel coding", and "digital communication subjects". Recently, he focuses on over capacity data transmission using polar codes. He is also interested in practical applications of communication systems involving FPGA devices. He is delivering courses with titles "VHDL circuit design", "interface design using VHDL for FPGA devices" and "system on chip design".

Materials to be included: Lecture slides will be provided.

Decision (Run/Cancel) Date for this Course is Tuesday, February, 23, 2021

IEEE Members	**$250**
Non-members	**$300**

http://ieeeboston.org/event/polar-codes-encoding-and-decoding-aspects-live-webinar/?instance_id=2965

Software Development for Medical Device Manufacturers

Web-based Course with live Instructor!

(11 hours of instructions!)

Times & Dates: 1:00 - 4:00PM ET, May 3, 4, 5, 6, 2021

Speaker: Steve Rakitin, Software Qualtiy Consulting

Course Format: Live Webinar, four, 3 hour sessions

COURSE SUMMARY: Developing software in compliance with the FDA Design Control regulation, changing FDA guidance documents and latest international standards is challenging. This intensive course provides practical solutions and suggestions for developing software in a manner that meets applicable FDA regulations, guidance documents and international standards, such as IEC-62304:2015. The focus is on interpreting Design Controls for software. Each section of the Design Controls regulation (820.30) is discussed from the perspective of software development. Discussions on key topics such as Software Requirements, Traceability, Design Reviews, Software Verification & Validation and Risk Management (including recently updated standards ISO-14971:2019 and EN-14971:2019) are included. Also discussed are FDA requirements for validation of software development tools and software used in Manufacturing and Quality Systems. Also discussed are recent FDA Guidance Documents on Cybersecurity, Mobile Apps, and Usability.

THIS COURSE IS INTENDED FOR: Software engineers, project managers, quality managers, software quality professionals, RA/QA staff, and anyone who needs to develop cost-effective processes and procedures that will enable their organizations to deliver high quality software-based medical devices that comply with FDA regulations and international standards. This course is also appropriate for people who are new to the medical device industry. Course notes, access to an extensive collection of reference documents and a training certificate are provided.

COURSE OUTLINE: This course will be presented with a live instructor using web-meeting software. The course content will be covered in 4 sessions as described below.

SESSION 1 – Regulatory Context

Duration ~3 hours with one 15 min break

This session will cover key regulatory requirements for medical device software in the US and EU.

Regulations and Guidance:

- FDA Medical Device Regulation (21 CFR Part 820 – specifically, design controls)
- EU Medical Device Regulation
- FDA Guidance Documents:
- Guidance for Content of Pre-market Submissions for Medical Devices Containing Software
- Off-the-Shelf Software Use in Medical Devices
- General Principles of Software Validation
- Content of Premarket Submissions for Management of Cybersecurity in Medical Devices
- Policy for Software Device Functions and Mobile Medical Applications
- Applying Human Factors and Usability Engineering to Medical Devices

International Standards:

- ISO 13485:2016 Medical Devices – Quality Management Systems
- IEC 62304: 2015 Medical Device Software – Software Lifecycle Processes
- ISO 14971: 2019 Application of Risk Management to Medical Devices

• EN 14971: 2019 Application of Risk Management to Medical Devices
• Off-the-Shelf (OTS) Software and Open Source software (SOUP)
• Discussion: All Software Is Defective…

SESSION 2 – FDA Design Controls and IEC 62304 – Part 1
Duration ~2.5 hours with one 15 min break
This session will cover FDA Design Controls and IEC 62304 requirements for medical device software.

• Design and Development Planning
    • How does Agile Development fit?
    • Medical Device Software Lifecycle Processes
• Risk Management
    • FDA Levels of Concern
    • IEC 62304 Software Safety Classification
• Software Requirements
    • Techniques for Removing Ambiguity from Requirements
• Software Architecture and Design
• Software Design Changes

SESSION 3 – FDA Design Controls and IEC 62304 – Part 2
Duration ~2.5 hours with one 15 min break
This session will cover Software Verification and Validation requirements.

• Software Implementation
• Software Verification
    • Technical Reviews
    • Static Analysis
    • Unit and Integration Testing
• System Testing
• Software Validation Testing

SESSION 4 – Software Tool Validation and Risk Management
Duration ~2.5 hours with one 15 min break
This session will cover Software Tool Validation and Risk Management requirements.
• Software Tool Validation
    • Deciding which tools need to be validated
    • Validation approach for software tools
• Validation of Manufacturing Software and Quality System Software
• Risk Management Using Fault Tree Analysis (FTA)
    • Review of ISO/EN 14971:2019 Requirements
    • Example of Fault Tree Analysis and Failure Modes Effect Criticality Analysis (FMECA)

About the instructor: Steven R. Rakitin has over 45 years experience as a software engineer. He has over 30 years of experience in the medical device industry and has been a medical device consultant for over 20 years. He has worked with over 100 medical device manufacturers and biotech companies worldwide, from startups to Fortune 100 corporations. He has published papers on medical device software risk management as well as a book titled: Software Verification & Validation for Practitioners and Managers.

He received a BSEE from Northeastern University and an MSCS from Rensselaer Polytechnic Institute. He earned certifications from the American Society for Quality (ASQ) as a Software Quality Engineer (CSQE) and Quality Auditor (CQA). He is a Senior Life member of IEEE.

Steve works collaboratively with medical device companies to help them comply with FDA regulations, guidance documents, and international standards in an efficient and cost-effective manner.

Decision (Run/Cancel) Date for this Course is Monday, April 26, 2021

IEEE Members	**$285**
Non-members	**$345**

http://ieeeboston.org/event/live-course-software-development-for-medical-device-manufacturers/

IEEE Boston Section

Ansys

Electronic Reliability Tutorial Series -

Electronic Failures and Mitigation Methods from a Component, Design and Process Perspective

Five new, LIVE WEBINAR courses!

Times & Dates: Each session starts at 11:00 ET, April 29, May 6, 13, 20, 25

Speakers: Greg Caswell, Dock Brown, Ashok Alagappan, David Spitz, Ansys

Electronics perform critical functions in every major industry vertical, whether in automotive, aerospace, consumer, medical or industrial segments. With the advent of newer technologies (both at the component and material levels), shrinkage of feature sizes, more stringent environments and sophisticated power requirements, electronics face increasing reliability risks. Supply chain trends have changed over the years from a vertically integrated model to a more geographically diverse supply chain. All these trends have increased reliability risks for companies. However, the cost of reliability assurance activities is often a fraction of the cost of failure, with compounding benefits from conducting these activities early in the design process.

This set of five tutorials brings together the experience of industry reliability experts and highlights electronic failures due to technology changes, changing supply chain, and mitigation methods from a design, component, and process perspective. Tutorials that specifically address connectors, Commercial Off the Shelf (COTS) parts, identify issues and implement Design for Manufacturing (DfM) methodologies, root causes and mitigation strategies for Electrical overstress (EOS) failures, will comprise the series.

Series Tutorial Session Ttiles

You can view detail session descriptions once you click on the individual sessions once you access the main series webite. See the link at the end of the course notice.

1) Reliability Challenges with the Use of Multilayer Ceramic Chip Capacitors

2) How to Avoid Common Failures with Connectors in Electronic Assemblies

3) How to Ensure Reliability with Commercial Off the Shelf (COTS) Electronic Parts

4) Design for Manufacturability (DfM) – Optimizing the Board Assembly Process for Reliability

5) Why Electrical Overstress Ranks High in the IC Field Failure Pareto

Target Audience: Engineers/managers involved in the design, manufacturing and/or reliability of electronic products/systems, and complex printed circuit board assemblies.

Benefits of Attending

- How to avoid common mistakes in the use of MLCCs
- Mitigation methods for the relevant MLCC failure modes
- How to avoid common mistakes in connector design and applications
- Mitigation methods for the relevant failure modes for connectors
- How to avoid common mistakes in use of COTS components
- Mitigation methods for the relevant failure modes in the use of COTS components
- Gain an understanding of different failure modes,

associated with manufacturing
- Learn the process for assessing the design and enhance manufacturability with each level of electronic packaging/assembly
- Mitigation methods for the relevant failure modes
- Learn about the impact of Electrical Overstress (EOS) on semiconductor devices
- Learn about the Impact of Absolute Maximum Rating (AMR) on EOS failures
- Root Causes of EOS failure mechanisms
- Mitigation methods for the relevant failure modes

Greg Caswell, a Lead Consulting Engineer for Ansys Corporation, is an industry recognized expert in the fields of SMT, advanced packaging, printed board fabrication, circuit card assembly, and bonding solutions using nanotechnology. He has been well-regarded as a leader in the electronics contract manufacturing and component packaging industries for the past 50 years. He has presented over 270 papers at conferences all over the world and has taught courses at IMAPS, SMTA and IPC events. He helped design the 1st pick and place system used exclusively for SMT in 1978, edited and co-authored the 1st book on SMT in 1984 for ISHM and built the 1st SMT electronics launched into space. Be on the lookout for his new book entitled Design for Excellence in Electronics Manufacturing due out in September 2020. Greg has won several awards including the IMAPS Lifetime Achievement Award in 2018, the ISHM Daniel C. Hughes Award (highest award given to an individual), ISHM Fellow of the Society Award and the Tracor Technical Innovation Award.

Dock Brown brings his more than 30 years of electronics reliability experience to clients of Ansys. Prior to joining Ansys, he spent 20 years at Medtronic where he most recently concentrated on cross business unit implementation of reliability initiatives for Class III medical devices. He was also responsible for supplier assessment and approval, on-going supplier audits, failure analysis, corrective actions, MRB, sampling, and ultimately full accountability for quality and reliability of COTS and custom parts and assemblies from a worldwide supplier base. Earlier in his career, Mr. Brown also spent time at Sundstrand Data Control where he led the implementation of the Boeing AQS program and with Olin Aerospace.

David Spitz, a Lead Consulting Engineer with Ansys Corporation, has over 30 years of experience in PCBA manufacturing with tier 1 contract manufacturers Texas Instruments, Solectron, and Flex. During that time, he has held various technical leadership roles including SMT and DFM Engineering, and his background has encompassed both NPI and Production environments. David has expertise in BGA/CSP attachment, solder paste printing, and SMT reflow soldering.

Ashok Alagappan has 15 years of experience in the Semiconductor industry, specializing in design and manufacturing of semiconductor products. He has managed products through their life cycle, from introduction in the Fab to qualification. At Ansys, he is working with customers across the spectrum, from aerospace, automotive to commercial, providing expert analysis and recommendations for defining and improving reliability of electronic products and IC components. He has developed an IC wear out tool to predict the lifetime characteristics of Integrated Circuit components in high reliability applications like aerospace, defense, automotive, among others. He has built models to characterize the intrinsic wear out failure mechanisms of ICs and has implemented the tool in the Ansys Sherlock ADA™ software product

Individual tutorial/session abstract, goals, benefits of attending, target audience can be found by clicking on the title of each tutorial/session once the main series site is accessed (see below) Upon entering the registration page, you will have the option of registering for one or more tutorials/sessions. We offer a 15% discount for 2-3 tutorials and 25% discount for 4-5 tutorials. You will be able to choose your tutorials/sessions from the registration page.

Decision (Run/Cancel) Date for this Course is Friday, April 23, 2021

Each session is a separate registration

IEEE Members - $80

Non-members - $100

http://ieeeboston.org/electronic-reliability-series-2/

Call for Articles

Now that the Reflector is all electronic, we are expanding the content of the publication. One of the new features we will be adding are technical, professional development, and general interest articles to our members and the local technology community. These will supplement the existing material already in our publication.

Technical submissions should be of reasonable technical depth and include graphics and, if needed, any supporting files. The length is flexible; however, a four to five page limit should be used as a guide. An appropriate guide may be a technical paper in a conference proceeding rather than one in an IEEE journal or transaction.

Professional development or general interest articles should have broad applicability to the engineering community and should not explicitly promote services for which a fee or payment is required. A maximum length of two to three pages would be best.

To ensure quality, technical submissions will be reviewed by the appropriate technical area(s). Professional/interest articles will be reviewed by the Publications Committee for suitability.The author will be notified of the reviewers' decision.

The Reflector is published the first of each month. The target submission deadline for the articles should be five weeks before the issue date (e.g., June 1st issue date; article submission is April 27). This will allow sufficient time for a thorough review and notification to the author.

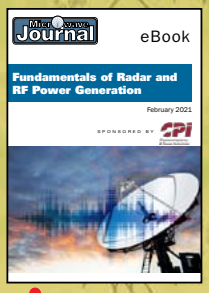
We are excited about this new feature and hope you are eager to participate!
Submissions should be sent to;
ieeebostonsection@gmail.com

This Month

Catch up on the latest industry news with the bi-weekly video update **Frequency Matters**

Explore Microwave Journal Online

eBooks



Frequency Matters PODCASTS
5G • IoT • A&D

Evolution of Radar to Full 4D Imaging, Vayyar Imaging

5G mmWave Market Review and Forecast, GSMAi

State of HAM Radio, Eric Guth, HAM Radio Expo

Microwave Journal

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MWJ

Virtual Panel Session

Will Flat Panel Phased Arrays Meet the SATCOM Challenge?

March 24 **11am ET**

E-Learning Center

Access webinars on-demand from the archived webinars and events page

CALL FOR PAPERS

www.ieee-hpec.org

A Note from the HPEC Committee:
IEEE HPEC 2021 will be presented as a virtual conference that will allow safe participation and full publication in IEEE Xplore.

The IEEE High Performance Extreme Computing Conference (HPEC '21) will be held in the Greater Boston Area, Massachusetts, USA on 21 – 23 September 2021. The HPEC charter is to be the premier conference in the world on the confluence of HPC and Embedded Computing.

The technical committee seeks new presentations that clearly describe advances in high performance extreme computing technologies, emphasizing one or more of the following topics:

- AI / Machine Learning
- Graph Analytics & Network Science
- Advanced Multicore Software Technologies
- Advanced Processor Architectures
- Automated Design Tools
- Big Data & Distributed Computing
- Big Data Meets Big Compute
- Case Studies & Benchmarking of Applications
- Cloud HPEC
- Computing Technologies for Challenging Form Factors
- ASIC & FPGA Advances
- Quantum and Non-Deterministic Computing
- Data Intensive Computing
- Digital Front Ends
- Fault-Tolerant Computing
- Embedded Cloud Computing
- General Purpose GPU Computing
- High Performance Data Analysis
- Interactive and Real-Time Supercomputing
- Mapping & Scheduling of Parallel & Real-Time Applications
- New Application Frontiers
- Open System Architectures
- Cyber Analysis and Secure Computing

HPEC accepts two types of submissions:	**IMPORTANT DATES**:
1. Full papers (up to 6 pages, references not included; additional pages can be purchased for $200/page). 2. Extended abstracts (up to 2 pages, references included).	Submission Deadline: **JUL 9, 2021** Notification of Acceptance: **AUG 13, 2021** Camera Ready Deadline: **AUG 31, 2021**

Preference will be given to papers with strong, quantitative results, demonstrating novel approaches or describing high quality prototypes. Authors of full papers can mark their preference for a poster display or an oral presentation. Presenters who wish to have hardware demonstrations are encouraged to mark their preference for a poster display. Accepted extended abstracts will be displayed as posters. Papers can be declared "student paper" if the first author was a student when doing the presented work, and will be eligible for the "IEEE HPEC Best Student Paper Award." Papers should not be anonymized. All paper and extended abstract submissions need to use the approved IEEE templates. Full paper submissions with the highest peer review ratings will be published by IEEE in the official HPEC proceedings available on IEEE eXplore. All other accepted submissions and extended abstracts are published on ieee-hpec.org.

Vendors are encouraged to sign up for vendor booths. This will allow vendors to present their HPEC technologies in an interactive atmosphere suitable for product demonstration and promotion. We welcome input (hpec@ieee-hpec.org) on tutorials, invited talks, special sessions, peer reviewed presentations, and vendor demos. Instructions for submitting will be posted on the conference web site shortly.

HPEC 2021

SEPTEMBER 21 – 23