

# BOSTON



# THE REFLECTOR

ISSUE #3  
MARCH 2019

2019 IEEE PHASED  
ARRAY SYMPOSIUM  
*CFP DEADLINE  
MARCH 15, 2019*

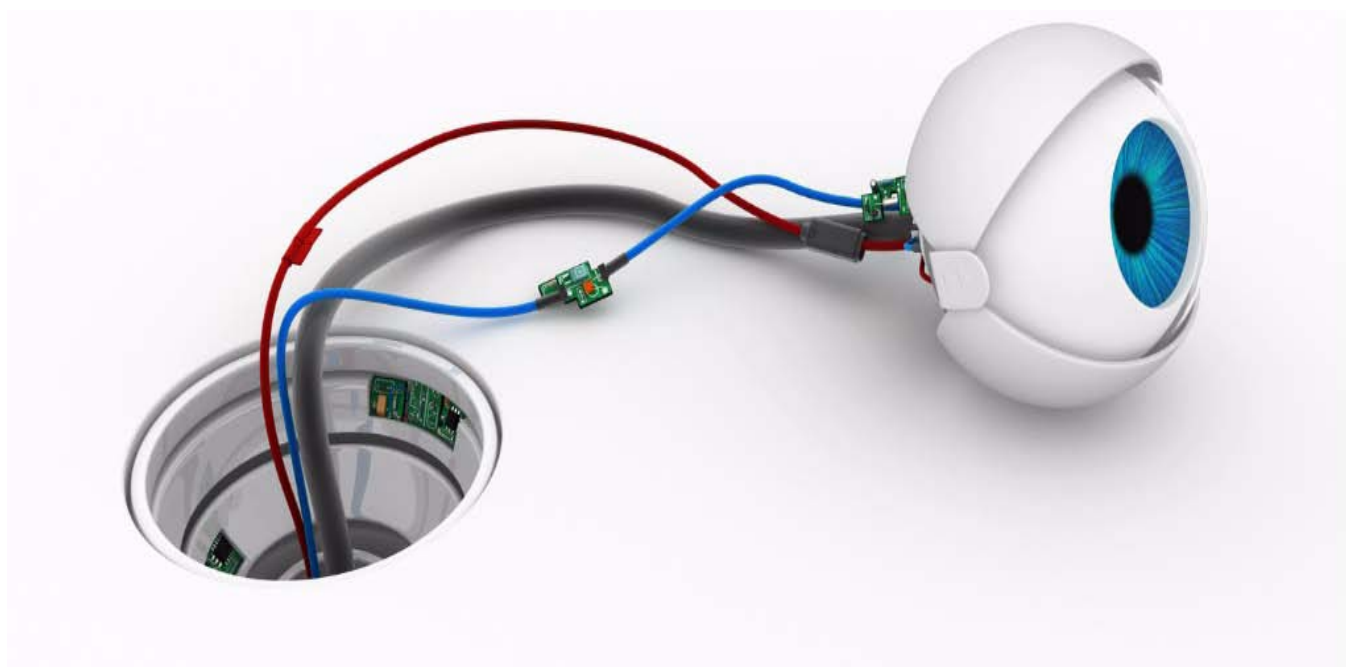
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2019 IEEE RADAR  
CONFERENCE

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HIGH  
PERFORMANCE  
EXTREME  
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**2018 Outstanding Section Membership  
Recruitment and Retention Performance**

**Boston Section**

 **IEEE**  
*Advancing Technology  
for Humanity*

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## Old People

Karen Panetta, Reflector, Editor

In 1977, Artist Randy Newman released a song called “Short People.” The lyrics go on a litany of negative character traits of short people and the chorus chants “don’t want any short people around here.” Some of the character traits depicted in the song imply short people are liars and are out to get you. If the song were released today, the artist would most likely have to go into hiding to avoid death threats.

The artist’s intent was to choose a random physical characteristic of people and show how ridiculous it was to associate personality traits that have absolutely no correlation to a person’s height. His song most likely would have evoked the same reaction if he had replaced the words “short people” with “blue eyed people” or “people who open their eggs at the small end.” The point was, he was trying to say that attributing character traits to people based on some random discriminating factor was stupid.

I bring this up because we keep hearing about the shortage of qualified engineers in the U.S. and yet, there are thousands of well-qualified engineers out there and out of work. What’s wrong with these unemployed engineers that no one wants to hire them you ask? They are old.

Now, what exactly is old? That depends on who you ask. For most of the situations I have been observing lately, old means someone older than the person singing the tune “don’t want any old people around here.” So let’s say the person singing is 44 years old, then by that standard, 50 is considered old and 60 means you should just climb in the box and close the lid. To these small minded boobs, a person over 60 is elderly and useless. You may have met a few of these “old

people lives don’t matter” types in meetings using statements like, “we expect retirements in the department soon,” believing they are being tactful in pushing the oldest group members out the door right, while the “old” people are sitting in the same meeting.

After all, these experienced older individuals are known for their ability to point out naïve and stupid decisions that will make the project fail. Now, who wants someone around like that? Quick! Find some icebergs and let’s float them all out to sea!

Every time I encounter a person singing, “Don’t want any old people around here”, I want to send them off to an IEEE Life Member meeting. The Life members are not the decrepit walking dead that older people have been stereotyped as, and more importantly, they are brilliant. Many of the Life Members are successful entrepreneurs and many are still working because they really are not “old.” They do not sit around in their meetings discussing the status of their hemorrhoids. They discuss complex global challenges facing humanity and yes, they are not shy about voicing their opinions, proposing solutions and identifying promising technologies of the future. Hearing them discuss the history of technology and how we got to where we are today, is a bonus. They invite promising young engineers to give talks and are eager to help students flourish.

Some of my greatest mentors are now Life members. Their candid advice, wisdom and encouragement has been the best value I received from my IEEE membership.

I do amaze my students with tales of the first electrified railway, the first wireless voice transmission, and

my dinners with famous engineers and scientists. How many people can say they got to brainstorm designing new signal processing algorithms to dampen background noise in large ballrooms with the late Ray Dolby?

In sports training, we are told to train with someone who is a stronger player than you are to help improve your game. Well, I believe it is the same for your brain. I find “brain training” with Life Members to be the equivalent. And all it takes is that people stop singing “don’t want any old people” and put on a miracle ear and start to listen. Only then, will they understand what a wonderful resource our Life members are.

It will be many, many, many more decades before I am eligible for Life Membership, but that’s okay. To my

20-year-old students, anyone over the age of 26 is considered old, so by their standard, I am eligible to be put on an iceberg and floated out to sea.

But I will let you in on a secret. All the older engineers floating together on that iceberg are really prototyping new propulsion systems and testing novel wave power renewable energy sources!

A person is eligible to become a life fellow after turning 65 years young. Becoming an IEEE Life Member is based on the number of years a person has been an IEEE member plus her/his age. If that number is greater than or equal to 100, you can be a life fellow and not pay any more IEEE dues. Visit [ieeeboston.org/life-members-affinity-group/](http://ieeeboston.org/life-members-affinity-group/) to learn more!

## Call for Articles

Now that the Reflector is all electronic, we are expanding the content the publication. One of the new features we will be adding are technical and professional development articles of interest 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 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 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](mailto:ieeebostonsection@gmail.com)**

# IEEE Boston Section Spring 2019 Professional Development Program

## Practical RF PCB Design, Wireless Networks, Products and Telecommunications

(14 hours of instructions!)

**Dates:** 9:00AM - 4:30PM, Monday & Tuesday, April 8 & 9 (Note New Dates!!)

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Henry Lau, Lexiwave Technology

**Overview:** One of the most demanding consumer products in the market is the wireless telecommunication product. A well-designed Radio Frequency Printed Circuit Board (RF PCB) contributes significantly to the success of any wireless product as the layout of the PCB greatly affects the performance, stability and reliability of the product. In today's highly competitive wireless products market with increasingly compressed development time-frame, there is a strong demand for RF professionals who possess the knowledge and experience to design top-performing RF PCBs in less number of iterations. What matters is whether your level of competence is up to the required standard to meet such demand.

**Audience:** RF Designers, Wireless Product Designers, Field Application Engineers, Design Managers and related professionals.

**Benefits:** This course aims to provide participants with an insightful training on RF PCB design from a practical, industrial perspective. Participants will be led through a systematic, theoretical presentation with case studies on commercial products in the training. The course will be conducted by an RF expert with rich industrial experience. It is suitable for RF professionals who want to keep up-to-date their skills and knowledge in RF PCB design and stay competitive.

**See Page 24**

**Full Course description at :**

<http://ieeeboston.org/practical-rf-pcb-design-wireless-networks-products-telecommunications-spring-2019/>

## Software Development for Medical Device Manufacturers - An intensive two-day course

**Time & Date:** 8:30AM - 4:30PM, Wednesday & Thursday, April 10 & 11, 2019

(14 hours of instruction!)

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Steve Rakitin, President, Software Quality Consulting, Inc.

**OVERVIEW** Developing software in compliance with FDA, EU regulations and international standards is challenging. This two-day intensive course provides practical guidance and suggestions for developing software that complies with applicable FDA and EU regulations, guidance documents and international standards such as IEC 62304 and ISO 14971. The focus of this course is interpreting Design Controls for software. Each section of the Design Controls regulation (820.30) is discussed from the software perspective. Corresponding requirements from IEC 62304 are woven into the flow.

In-depth discussion of critical topics such as Requirements, Software Verification & Validation, Risk Management and Fault Tree Analysis are included. In addition, techniques for validating software development tools and software used in Manufacturing and Quality Systems are also discussed. Interactive group exercises are included to facilitate discussion and learning.

**WHO SHOULD ATTEND** Software and firmware engineers, software managers, RA/QA staff, validation engineers, and project managers. Anyone interested in learning how to develop medical device software in compliance with regulations, standards and guidance documents. **See Page 26**

**Full course Description at,** <http://ieeeboston.org/software-development-medical-device-manufacturers>

continued on next page

## The Fundamentals of Bioelectronics for Applications in Neuroprosthetics

**Time & Date:** 8:00AM - 3:00PM, Friday, April 12, 2019

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Marie Tupaj, Middlesex Community College

**Description:** This course covers the field of bioelectronics, specifically electrode design and implementation, for applications in neuroprosthetics. Electrode materials, electrode array fabrication, electrode modeling, electrical stimulation parameters, bioelectrode charge transfer mechanisms, and interfaces with biological systems are discussed. The fundamental theories of electromagnetism and a history of bioelectromagnetics are reviewed.

**Target Audience:** This class is designed for engineers transitioning into the field of bioelectronics, electronics engineers interested in neurobiologics, and professionals looking for an understanding of bioelectronics to complete their job. **See Page 25**

Full description at,

<http://ieeeboston.org/fundamentals-of-bioelectronics-for-applications-in-neuroprosthetics/>

**(LAST NOTICE, PLEASE REGISTER NOW!!!!)**

## Python Applications for Digital Design and Signal Processing (11 hours of instruction!)

**Time & Date:** 6:00 - 9:00PM, Wednesdays, March 6, 13, 20, 27

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Dan Boschen

### Course Summary

This is a bring-your-own laptop, hands-on course in the popular and powerful open source Python programming language. Dan provides simple, straight-forward navigation through the multiple configurations and options, providing a best-practices approach for quickly getting up to speed using Python for solving signal processing challenges. Students will be using the Anaconda distribution, which combines Python with the most popular data science applications, and the Jupyter Notebooks for a rich, interactive experience.

**Jupyter Notebooks** This course makes extensive use of Jupyter Notebooks which combines running Python code with interactive plots and graphics for a rich user experience. Jupyter Notebooks is an open-source web based application (that can be run locally) that allows users to create and share visually appealing documents containing code, graphics, visualizations and interactive plots. Students will be able to interact with the notebook contents and use “take-it-with-you” results for future applications in signal processing.

**Target Audience:** This course is targeted toward users with little to no prior experience in Python, however familiarity with other modern programming languages and an exposure to object-oriented constructs is very helpful. Students should be comfortable with basic signal processing concepts in the frequency and time domain. Familiarity in Matlab or Octave is not required, but the equivalent operations in Python using the NumPy package will be provided for those students that do use Matlab and/or Octave for signal processing applications.

**See Page 27**

Full Description at, <http://ieeeboston.org/python-for-signal-processing/>

**DSP for Wireless Communications (13 hours of instruction!)****Time & Date:** 6:00 - 9:00PM, Tuesdays, April 9, 16, 23, 30, May 7**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA**Speaker:** Dan Boschen

**Course Summary:** This course is a fresh view of the fundamental 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 bring a laptop to class, and all set-up information for installation will be provided prior to the start of class. **See Page 30**

**Full Description at,****<http://ieeeboston.org/digital-signal-processing-dsp-wireless-communications/>****DSP for Software Radio (13 hours of instruction!)****Time & Date:** 6:00 - 9:00PM, Wednesdays, May 15, 22, 29, June 5, 12**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA**Speaker:** Dan Boschen

**Course Summary** This course builds on the IEEE course “DSP for Wireless Communications” also taught by Dan Boschen, further detailing digital signal processing most applicable to practical real-world problems and applications in radio communication systems. Students need not have taken the prior course if they are familiar with fundamental DSP concepts such as the Laplace and Z transform and basic digital filter design principles. The course title has been changed with some minor additions but this is the same course that was previously taught titled “More DSP for Wireless Communications”, with the addition of Python demonstrations using Jupyter Notebooks.

**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.

**Target Audience:** All engineers involved in or interested in signal processing for wireless communications. Students should have either taken the earlier course “DSP for Wireless Communications” or have been sufficiently exposed to basic signal processing concepts such as Fourier, Laplace, and Z-transforms, Digital filter (FIR/IIR) structures, and representation of complex digital and analog signals in the time and frequency domains. Please contact Dan at [boschen@loglin.com](mailto:boschen@loglin.com) if you are uncertain about your background or if you would like more information on the course. **See Page 32**

**Full description at, <http://ieeeboston.org/digital-signal-processing-dsp-wireless-communications-2/>**

# **IEEE Boston Section Online Courses:**

**(Students have 90 day access to all online, self-paced courses)**

## **Verilog101:Verilog Foundations**

Full course description and registration at ,  
<http://ieeeeboston.org/verilog-101-verilog-foundations-online-course/>

## **System Verilog 101: Design Constructs**

Full course description and registration at ,  
<http://ieeeeboston.org/systemverilog-101-sv101-design-constructs-online-course/>

## **System Verilog 102: Verification Constructs**

Full course description and registration at ,  
<http://ieeeeboston.org/systemverilog-102-sv102-verification-constructs-online-course/>

## **High Performance Project Management**

Full course description and registration at ,  
<http://ieeeeboston.org/high-performance-project-management-online-course/>

## **Introduction to Embedded Linux Part I**

Full course description and registration at ,  
<http://ieeeeboston.org/introduction-to-embedded-linux-part-i-el201-online-course/>

## **Embedded Linux Optimization - Tools and Techniques**

Full course description and registration at ,  
<http://ieeeeboston.org/embedded-linux-optimization-tools-techniques-line-course/>

## **Embedded Linux Board Support Packages and Device Drivers**

Full course description and registration at ,  
<http://ieeeeboston.org/embedded-linux-bsps-device-drivers-line-course/>

## **Software Development for Medical Device Manufacturers**

Full course description and registration at ,  
<http://ieeeeboston.org/software-development-medical-device-manufacturers-line-course/>

## **Fundamental Mathematics Concepts Relating to Electromagnetics**

Full course description and registration at ,  
<http://ieeeeboston.org/fundamental-mathematics-concepts-relating-electromagnetics-line-course/>

## **Reliability Engineering for the Business World**

Full course description and registration at ,  
<http://ieeeeboston.org/reliability-engineering-business-world-line-course/>

## **Design Thinking for Today's Technical Work**

<http://ieeeeboston.org/design-thinking-technical-work-line-course/>

## **Fundamentals of Real-Time Operating Systems**

<http://ieeeeboston.org/fundamentals-of-real-time-operating-systems-rt201-on-line-course/>

## March Chapter Meeting Summary

### **Entrepreneur's' Network – 6:30PM, Tuesday, 5 March**

#### **Staffing for Entrepreneurial Success**

You have a startup; you need more people. Where do you start? This panel discussion is exactly for you. Staffing properly can make or break your company. In this dynamic session, we discuss topics including: developing a staffing plan, the benefits of an organizational chart, the different types of staffing, and recruiting strategies. Then we will discuss retaining employees; benefits and compensation plans, creating team culture, managing growth, and communication. Meeting Location: Constant Contact, Inc., Reservoir Place, 3rd Floor Great Room, 1601 Trapelo Rd., Waltham, MA. **See Page 11.**

### **Entrepreneur's Network – Boston Meeting – 6:00PM, Tuesday, 12 March**

#### **Startup Success is Sales & Marketing ... and More**

Learn startup basics and complexities. Hear stories of success and failures in an interactive audience forum. We are featuring Jack Derby, Mass High Tech All-Star, co-founder of 9 companies, investor in 54 companies and Professor of Entrepreneurship. The session will be part presentation, part lecture, part Q&A across all facets driving startup success. Bring your questions, your startup challenges, and learn steps required to drive your startup success. Meeting Location: Draper Labs, Hill Building, One Hampshire Street, Cambridge, MA. **See Page 13.**

### **Reliability Society – 5:30PM, Wednesday, 13 March**

#### **ESD QMS Best Practices Strategy for Class 0**

While most companies are acutely aware of the hazards of ESD (electrostatic discharge), few are aware that the ESD QMS (Quality Management System) Strategy is equally important as the technical requirements. This is especially true for the extreme ESD sensitivities of Class 0 since the trend toward Class 0 devices is escalating rapidly. Furthermore, most companies do not know what their device sensitivities are because 90% of IC data-sheets do not include CDM (Charged Device Model) Sensitivity data. The absence of this data and the lack of understanding of ESD QMS best practices have reached a critical stage. Meeting Location: MIT Lincoln Laboratory, 3 Forbes Rd, Lexington, MA, 02421. **See Page 14**

### **Life Members and co-sponsoring Photonics Society – 4:00PM, Wednesday, 13 March**

#### **Personal Experience of a Congressional Fellow – or (with apologies to James Stewart and Frank Capa) Mr. Eichen Goes to Washington**

Since 1973, the IEEE-USA government fellowship program has sponsored more than 120 U.S. IEEE members to work for one year as advisors to Members of Congress, the State Department, or USAID. These IEEE-USA fellows are part of a larger science and technology fellowship community in which many professional organizations - representing the full spectrum of physical, mathematical, engineering, biological, and social sciences - sponsor fellows in congressional offices, and in almost all federal agencies. IEEE fellows (and science and technology fellows in general) are highly respected and in great demand on the hill. Many fellows remain in public policy (including a few who have run for Congress), while others use the experience to remain engaged and advance their own careers after returning to their academic or institutional positions. Meeting Location: MIT Lincoln Laboratory's Main Cafeteria, 244 Wood Street., Lexington, MA at 4:00 PM. **See Page 15.**

## **Power & Energy Society – 6:00PM, Tuesday, 19 March**

### **Leveraging Machine Learning Approach to Optimize the Participation of a Wind and Storage Power Plant**

Speaker: Md. Noor-E-Alam, PhD, Assistant Professor, Department of Mechanical & Industrial Engineering, Northeastern University. Variable energy resources such as wind farms and solar photovoltaic plants have started to play a significant role in power markets worldwide. However, challenges are faced with decision making due to the uncertainty associated with energy prices and available energy. In many markets, decisions on the amount of energy a plant commits to buy/sell must be made ahead of time before accurate information on such parameters are made available. Meeting Location: National Grid, 40 Sylvan Road, Waltham, MA 02451 (Rooms: Valley A&B). **See Page 16**

## **Computer Society and GBC/ACM – 7:00PM, Thursday, 28 March**

### **Julia Programming -- Humans Compose When Software Does**

We have found that the Julia language, through its composable abstractions, multiple dispatch, and expressive typing is accelerating the formation of bridges at MIT. As physical bridges may be made from steel and provide infrastructure for many to cross, it seems Julia's language elements are the medium that allow people to connect to solve hard problems. In this talk we will give a quick introduction to Julia, and then speak in depth about some of Julia's special features. Meeting Location: MIT Room 32-G449 (the Kiva conference room on the 4th floor of the Stata Center, building 32 on MIT maps). **See Page 17.**

## **Call for Articles**

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We are excited about this new feature and hope you are eager to participate!

**Submissions should be sent to;**  
**ieebostonsection@gmail.com**

*Entrepreneur's Network – 6:30PM, Tuesday, 5 March*

## Staffing For Entrepreneurial Success

**Location:** *Constant Contact, Inc., Reservoir Place, 3rd Floor Great Room, 1601 Trapelo Rd., Waltham, MA*

You have a startup, you need more people. Where do you start? This panel discussion is exactly for you. Staffing properly can make or break your company. In this dynamic session, we discuss topics including: developing a staffing plan, the benefits of an organizational chart, the different types of staffing, and recruiting strategies. Then we will discuss retaining employees; benefits and compensation plans, creating team culture, managing growth, and communication.

These discussions will focus on real world examples from seasoned entrepreneurs, equity partners, and recruiters.

### Agenda:

6:30-7:30 PM - Registration & networking  
 7:30-7:40 PM - ENET Chairman's announcements  
 7:40-7:55 PM - E Minute - Up to 3 Startup companies' presentations  
 7:55-8:45 PM - 4 expert speakers on the night's topic  
 8:45-9:00 PM - Audience / Speakers Q & A  
 9:00-9:30 PM - Final networking includes meeting presenting speakers

A question and answer session follow the presentation, and panelists will be available afterward for responses to individual questions. As with every ENET meeting, you will also get the chance to network with the panelists and other meeting attendees, both before the start of the meeting and afterward.

### Panelists:



Garry Bear, Dynamic & Innovative Engineering Leader  
 Entrepreneurial and innovative technology Leader (CTO, VP, Director) with proven leadership of creating and implement product roadmaps that engage customers and grow the business. Successfully lead organizations through market,

technology, and people changes to achieve growth, as well as operations integration via acquisitions and mergers. A collaborative leader with a pragmatic approach on coaching teams into high performing agile behavior. My passion is driving business change with technology innovation and team-building, driven by revenue and profitability objectives.

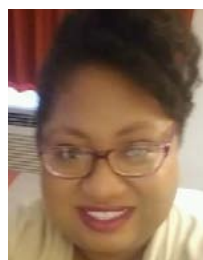
Garry has held leadership roles at EXFO, Always There Homecare, Axeda, Percussion Software, Cymfony Technologies, Saba, Kronos, and Octave Communication.



Praveen Sahay, Founder & Managing Director, WAVE Equity Partners

Praveen is founder and managing director at WAVE Equity Partners, which invests in innovative high growth companies in the energy, food and water industries. Typical investment amounts in a company, across 2-3 rounds, are \$10-20M. Praveen is

a graduate of The University of Chicago Booth School of Business.



Michaun Fowler, CEO/President HR TROOPS

Experienced entrepreneur with a demonstrated history of working as a Human Resource professional. Skilled in Organizational Management, Training, Coaching, Sales, Customer Relationship Management (CRM), Team

Building, Staffing and Recruiting. Strong business development professional with experience in E Learning platforms and Social Media marketing. Goal is to help small to mid-size companies lay a solid foundation focused on compliance and professional development.

Tyler Pearl, Recruiting Manager, The Davis Companies  
 I lead our New England Engineering Recruiting Division at the DAVIS Companies. We place Embedded Software Engineers, Software Quality Engineers, User Interface Engineers, Mechanical Engineers, Firmware



Engineers, Manufacturing Engineers, Quality Engineers, and Engineering Executives in medical device, robotics, defense, and consumer electronics. Our niche recruiting focus enables us to connect top engineering talent with some of the most innovative technology companies in the area. Tyler is a graduate of Saint Michael's College.

#### Moderator and Organizer:



Dan Skiba, President & CEO GOT Interface, Vice Chair Boston ENET

As a Product Development Executive, I provide strategic leadership in product innovation and managing global teams, delivering award winning products to the international market. My ability to problem solve, direct the entire product development lifecycle and gain commitment to a common goal have driven faster release of products and market penetration.

By building synergies across engineering disciplines, I've designed products that result in 100% product utilization and seamless integration into customer environments. My skills in optimizing international resources has significantly reduced costs and streamlined production, delivering product excellence.

E-Minute Presentations will be given at the start of the meeting. These very short presentations enable young startup entrepreneurs to gain experience in presenting their summary business plans to expert panels and audiences.

Directions: Constant Contact is adjacent to RT 128 / 95 at Exit 28B. See: <http://www.constantcontact.com/about-constant-contact/office-location-waltham.jsp>

#### Registration:

ENET Member Rate - Free

MDG Member – \$15.00

Non-ENET Member Rate – \$20.00

Student – \$10.00

Register at <https://boston-enet.org/event-3097484>

PRE-MEETING DINNER at 5:15 PM (sharp) at Bertucci's, Waltham

Reservations: Please register at <https://boston-enet.org/event-3097484>. ENET Constant Contact meetings are free to ENET members and \$20 for non-members. No reservations are needed for the pre-meeting dinner. To expedite sign-in for the meeting, we ask that everyone -- members as well as non-members -- pre-register online. Pre-registration is available until midnight the day before the meeting. If you cannot pre-register, you are welcome to register at the door.

REFRESHMENTS: Snacks and soft drinks will be served at the meeting

### **IEEE Boston Section Social Media Links:**

**Twitter:** <https://twitter.com/ieeeboston>

**Facebook:** <https://www.facebook.com/IEEEBoston>

**YouTube:** <https://www.youtube.com/user/IEEEBostonSection>

**Google+:** <https://plus.google.com/107894868975229024384/>

**LinkedIn:** <https://www.linkedin.com/groups/IEEE-Boston-Section-3763694/about>

*Entrepreneur's Network – Boston Meeting – 6:00PM, Tuesday, 12 March*

# Startup Success is Sales & Marketing ... and More

**Location: Draper Labs, Hill Building, One Hampshire Street, Cambridge, MA**

Learn startup basics and complexities. Hear stories of success and failures in an interactive audience forum. We are featuring Jack Derby, Mass High Tech All-Star, co-founder of 9 companies, investor in 54 companies and Professor of Entrepreneurship. The session will be part presentation, part lecture, part Q&A across all facets driving startup success. Bring your questions, your startup challenges, and learn steps required to drive your startup success

## Agenda:

6:00-7:00 PM - Registration & networking  
 7:00-7:10 PM - ENET Chairman's announcements  
 7:10-7:25 PM - E Minute - Up to 3 Startup companies' presentations  
 7:25-8:15 PM - Expert speaker on the night's topic  
 8:15-8:30 PM - Audience / Speaker Q & A  
 8:30 - 9:00 PM - Final networking includes meeting presenting speaker

A question and answer session follows the presentation, and panelists will be available afterward for responses to individual questions. As with every ENET meeting, you will also get the chance to network with the panelists and other meeting attendees, both before the start of the meeting and afterward.

## Speaker and Moderator

Jack Derby, Director, Tufts Entrepreneurship Center, Cummings Family Professor of Entrepreneurship



Jack is responsible for the Tufts University Entrepreneurship Center where he teaches two courses and manages a highly engaged and active center of professors and students constituting the largest minor on campus. The Center

hosts 20+ entrepreneurship events each year culminating in the \$100K New Ventures Competition ranked by Forbes as one of the leading university competitions in

the U.S. Jack is passionate about Tufts and its students and has received the Henry and Madeline Fisher Award voted by the students as the most highly ranked teacher on campus.

Prior to forming a management consulting firm, Jack served as CEO of Mayer Electronics, President of CB Sports, President of Litton Industries Medical Systems, CEO of Datamedix and President of Becton Dickinson Medical Systems. For his work as an entrepreneur, co-founding nine companies, Jack was named to Mass High Tech's All-Star Team. He received the Pro Bono Publico Award from the Smaller Business Association of New England, the Meritorious Service Award from the Association for Corporate Growth, and the Vincent Fulmer Distinguished Service Award from the MIT Enterprise Forum where he served as Chairman.

He's an active board member in a number of companies and with a long investing history as an early stage investor as General Partner at Kestrel Ventures, Chairman of Common Angels and a General Partner at Converge Ventures.

E-Minute Presentations will be given at the start of the meeting. These very short presentations enable young startup entrepreneurs to gain experience in presenting their summary business plans to expert panels and audiences.

Registration: ENET Member - Free, Non-ENET Member – \$10.00

Registration:  
<https://www.boston-enet.org/event-2990362/Registration>

**COST AND REGISTRATIONS:** ENET meetings are free to ENET members and \$10 for non-members. To expedite sign-in for the meeting, we ask that everyone -- members as well as non-members -- pre-register for the meeting online. Pre-registration is available until midnight the day before the meeting. If you cannot pre-register, you are welcome to register at the door.

**REFRESHMENTS:** PIZZA, SALAD AND SOFT DRINKS

WILL BE SERVED AT THE MEETING.

**LOCATION:** Draper Laboratory, Hill Building, One Hampshire St. Cambridge, MA 02139 (directions). The entrance is called One Hampshire St but is actually on Broadway. Attendees must arrive at Draper Labs before 7pm. Entrance will be locked after 7pm.

**PUBLIC TRANSPORTATION:** Kendall Square stop on the Red Line.

**PARKING:** There is a public parking lot across the street from Draper. Also, \$10 parking is available after 6pm at Yellow Garage

[https://en.parkopedia.com/parking/garage/kendall\\_center\\_yellow\\_garage/02142/cambridge/](https://en.parkopedia.com/parking/garage/kendall_center_yellow_garage/02142/cambridge/) and Blue Garage [https://en.parkopedia.com/parking/garage/kendall\\_center\\_blue\\_garage/02142/cambridge/dd](https://en.parkopedia.com/parking/garage/kendall_center_blue_garage/02142/cambridge/dd)

*Reliability Society – 5:30PM, Wednesday, 13 March*

## ESD QMS Best Practices Strategy for Class

Ted Dangelmayer Dangelmayer Associates, LLC.



While most companies are acutely aware of the hazards of ESD (electrostatic discharge), few are aware that the ESD QMS (Quality Management System) Strategy is equally important as the technical requirements. This is especially true for the extreme ESD sensitivities of Class 0 since the trend toward Class 0 devices

is escalating rapidly. Furthermore, most companies do not know what their device sensitivities are because 90% of IC datasheets do not include CDM (Charged Device Model) Sensitivity data. The absence of this data and the lack of understanding of ESD QMS best practices have reached a critical stage.

S20.20 (ANSI/ESD S20.20) is the best industry standard available and is an excellent foundation for ESD QMS best practices programs. However, companies with advanced technologies have found they must customize the technical requirements of S20.20 and introduce sound ESD QMS practices to avoid unacceptable failure rates in the factory and field.

Join us for this interactive presentation and learn if you are at risk and how to establish a robust ESD QMS strategy. You will also learn how to obtain ESD CDM & HBM (Human Body Model) device sensitivity data as well as how to prepare for Class 0.

**Author Bio:** Ted Dangelmayer is the president of Dangelmayer Associates, LLC [Ted@Dangelmayer.com](mailto:Ted@Dangelmayer.com) 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, ESDA Marketing Team, Advanced Technologies Team, Nominations Committee and ESDA Publicity Team.

**MEETING LOCATION:** MIT Lincoln Laboratory, 3 Forbes Rd, Lexington, MA, 02421

Registration: [click here](#)

Copy and paste link

<http://ewh.ieee.org/r1/boston/rl/events.html>

Directions to 3 Forbes Road, Lexington, MA:

- Take Route 128/I-95 to Exit 30B, Route 2A Westbound.
- At the first traffic light, turn left onto Forbes Road.
- Go to the end of the street.
- At the traffic circle, turn right.
- Go halfway around the traffic circle and turn into the parking lot for MIT Lincoln Laboratory
- The main entrance is straight ahead, shared with “agenus”.

*Life Members and co-sponsoring Photonics Society – 4:00PM, Wednesday, 13 March*

# Personal Experience of a Congressional Fellow – or (with apologies to James Stewart and Frank Capa) Mr. Eichen Goes to Washington



Since 1973, the IEEE-USA government fellowship program has sponsored more than 120 U.S. IEEE members to work for one year as advisors to Members of Congress, the State Department, or USAID. These IEEE-USA fellows are part of a larger science and technology fellowship community in which many professional organizations - representing the full spectrum of physical, mathematical, engineering, biological, and social sciences - sponsor fellows in congressional offices, and in almost all federal agencies. IEEE fellows (and science and technology fellows in general) are highly respected and in great demand on the hill. Many fellows remain in public policy (including a few who have run for Congress), while others use the experience to remain engaged and advance their own careers after returning to their academic or institutional positions.

In September 2018 I began my year's IEEE-USA Congressional Fellowship working on cybersecurity, privacy, and government surveillance issues, and climate change research, in the office of Senator Ron Wyden (Oregon). While fellowship boilerplate descriptions typically read something like "congressional and agency fellowships provide a mechanism for scientists to learn firsthand about the public policy process while using

their knowledge, experience, and skills to address the challenges facing our country and the world," the reality is more nuanced. In this talk I hope to provide a personal perspective on the congressional fellowship – what fellows can realistically accomplish, how fellows can leverage the opportunity and ability to make connections in DC - as well as observations on how things actually seem to work (or not) on the hill.

Bio: Elliot Eichen retired as Director of Research and Development at Verizon, and Adjunct Faculty at Northeastern University in 2017. He has been a Visiting Industry Professor (optics) at Tufts University, Associate Editor of Photonics Technology Letters, program/conference chair for multiple conferences (including OFC, and the IEEE Optical Amplifier Conference), staff member at MIT, and served on grant committee for the NSF. He is author or co-author on more than 40 peer-reviewed publications and about 60 US Patents. Student's of Dr. Eichen are employed by all of the of the major US carriers and ISPs, many equipment and communication systems providers, and by multiple startups. Dr. Eichen received a B.S in physics from SUNY Stony Brook, and Ph.D. in optics from the University of Arizona.

The meeting will be held at MIT Lincoln Laboratory's Main Cafeteria, 244 Wood Street., Lexington, MA at 4:00 PM. Refreshments will be available at 3:30 PM. Please use the Wood Street Gate to the Laboratory. Follow signs from outside reception to the Main Cafete-

*Power & Energy Society – 6:00PM, Tuesday, 19 March*

# Leveraging Machine Learning Approach to Optimize the Participation of a Wind and Storage Power Plant

Speaker: Md. Noor-E-Alam, PhD, Assistant Professor, Department of Mechanical & Industrial Engineering, Northeastern University

*Refreshments start at 6:00PM, talk commences at 6:30PM.*



Variable energy resources such as wind farms and solar photovoltaic plants have started to play a significant role in power markets worldwide. However, challenges are faced with decision making due to the uncertainty associated with energy prices and available energy. In many markets, decisions on the amount of energy a plant commits to buy/sell must be made ahead of time before accurate information on such parameters are made available.

This talk discusses the issue of the above uncertainty from the perspective of a wind farm participating in various energy markets, including the day-ahead market. A framework for robust decision making is proposed with the objective of maximizing net profit. This framework aims at leveraging machine learning techniques to extract as much information as possible out of the available dataset.

At first, it finds patterns in the daily prices, then extract information out of the sequence in which those patterns appear. The first task is done by performing a multivariate clustering, and the second task is performed by a recurrent neural network-based multiclass classifier. Our simulation experiments showed that the resulting

framework has the potential to aid decision makers in managing operations and gaining competitive advantage.

Md. Noor-E-Alam is an Assistant Professor in the Department of Mechanical & Industrial Engineering at the Northeastern University. At Northeastern, Dr. Alam also holds a faculty associate position at Centre for Health Policy and Healthcare Research and an affiliated faculty position at Global Resilience Institute. Prior to his current role, he was working as a Postdoctoral Research Fellow at Massachusetts Institute of Technology, affiliated with Computer Science & Artificial Intelligence Laboratory (CSAIL), Operations Research Center (ORC), and Sloan School of Management. He has completed his PhD in Engineering Management in the Department of Mechanical Engineering at the University of Alberta (UofA) in 2013.

His current research interests lie in the intersection of operations research, artificial intelligence and big-data analytics, particularly as applied to healthcare, manufacturing systems and supply chain. He is currently serving as a board of director for IISE Logistics and Supply Chain division.

Meeting Location: National Grid, 40 Sylvan Road, Waltham, MA 02451 (Rooms: Valley A&B)  
Free and Open to the Public Visit the IEEE PES Boston Chapter website for further details  
<http://www.ieeepestboston.org/>

*Computer Society and GBC/ACM – 7:00PM, Thursday, 28 March*

# Julia Programming -- Humans Compose When Software Does

Alan Edelman, MIT

***This talk will be webcast on the MIT CSAIL Youtube channel <http://www.youtube.com/channel/UCYs2i-UgksAhgoidZwEAimmg>/live beginning at 7pm.***



We have found that the Julia language, through its composable abstractions, multiple dispatch, and expressive typing is accelerating the formation of bridges at MIT. As physical bridges may be made from steel and provide infrastructure for many to cross, it seems Julia's language elements are the medium that allow people to connect to solve hard

problems. In this talk we will give a quick introduction to Julia, and then speak in depth about some of Julia's special features.

Professor Alan Edelman (Math,CSAIL,CCE) loves to prove pure and applied theorems, program computers and everything in between. He has received many prizes including a Gordon Bell Prize, a Householder Prize, and a Charles Babbage Prize, is a fellow of IEEE,

AMS, and SIAM, and is a founder and chief scientist of Interactive Supercomputing and Julia Computing, Inc. He passionately believes in more interactions between classical computer science and computational science. Edelman's research interests include Julia, machine learning, high-performance computing, numerical computation, linear algebra, random matrix theory and geometry. He has consulted for IBM, Pixar, Akamai, Intel, and Microsoft among other corporations.

This joint meeting of the Boston Chapter of the IEEE Computer Society and GBC/ACM will be held in MIT Room 32-G449 (the Kiva conference room on the 4th floor of the Stata Center, building 32 on MIT maps). You can see it on this [map](#) of the MIT campus.

Up-to-date information about this and other talks is available online at <http://ewh.ieee.org/r1/boston/computer/>. You can sign up to receive updated status information about this talk and informational emails about future talks at <http://mailman.mit.edu/mailman/listinfo/ieee-cs>, our self-administered mailing list.

## IEEE Boston Section Social Media Links:

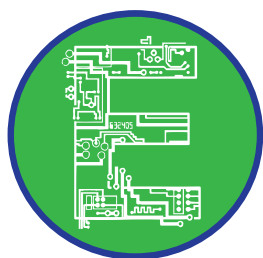
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**Power Amplifier Designs**  
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**Technical Education Training..... 3/26**  
**GaN-Based 5G and Pulsed Signal Measurements**  
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**Technical Education Training..... 3/28**  
**Critical Material Properties for Millimeter-Wave**  
**Radar Applications for Autonomous Driving**  
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## Past Webinars On Demand



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## 2019 IEEE International Symposium on Phased Array Systems and Technology

### Revolutionary Developments in Phased Arrays



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## 15–18 October 2019

Westin Waltham Hotel, Greater Boston, Massachusetts, USA

[www.array2019.org](http://www.array2019.org)

### About the Symposium

Phased array systems continue to be a rapidly evolving technology with steady advances motivated by the challenges presented to modern military and commercial applications. This symposium will present the most recent advances in phased array technology and provide a unique opportunity for members of the international community to interact with colleagues in the field of Phased Array Systems and Technology.



#### Sessions

- Array Design
- Array Measurements
- Beamforming and Calibration
- T/R Modules
- Radar Systems
- Communications Arrays
- Metamaterial Phased Arrays
- Signal Processing and Architectures
- Millimeter Wave and Terahertz

#### Special Sessions

- European Phased Array Systems and Technology
- Asia-Pacific Phased Array Systems and Technology
- Radio Astronomy and Geospace Arrays
- Dual-Polarization Weather Radar Arrays
- 5G (5th Generation Wireless) Phased Arrays
- Wideband Array Apertures

See website: [www.array2019.org](http://www.array2019.org) for details

#### General Paper Submission Information

All paper submissions will be peer reviewed and must be received in PDF format via the symposium web site on or before Friday, 15 March 2019. This is a firm deadline. Papers will not be accepted after this date. Papers must be in IEEE dual-column format and must be 2 pages (minimum) to 8 pages (maximum) in length including figures. Additional instructions are on the website

[www.array2019.org/call-for-papers](http://www.array2019.org/call-for-papers)

#### Paper Template and Submission Procedures

Template and submission procedures are available at [www.array2019.org/call-for-papers](http://www.array2019.org/call-for-papers)

### Technical Program Schedule

**Please note:** Our submission process and dates have been streamlined – plan accordingly.

**15 March 2019** – Full paper submission deadline

- Submitted paper must be final and in IEEE dual-column format, not an abstract
- Submitted paper must be 2–8 pages in length including figures

**30 April 2019** – Author notification of paper acceptance

**1 Sept. 2019** – Conference registration deadline for accepted authors

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## About the Conference

**22-26 April 2019**

Westin Waterfront Hotel  
Boston, Massachusetts, USA

[www.radarconf19.org](http://www.radarconf19.org)

A radar revolution is underway, made possible by the rapid evolution of digital electronics, and powered by new innovative architectures, advanced components, novel waveforms and sophisticated processing techniques. Please join us in historic Boston, birthplace of the original American Revolution, as we continue this new revolution in radar technology. The beautiful Westin Waterfront hotel, located in the heart of Boston's seaport district, will make the perfect venue for the international community as we meet to share the latest advances in radar. The conference will include three days of parallel technical sessions, and two days of tutorials with ample opportunity to interact with international radar experts from around the world.

## Technical Sessions

- Radar Phenomenology
- Environmental Sensing
- Commercial Radar
- Antenna Technology
- Radar Electronics
- Over the Horizon Radar (OTHR)
- Bistatic/Multistatic
- Passive Radar
- Networked & Distributed Radar
- mm-wave & THz Radar
- Detection & Estimation
- Airborne & Space Based
- SAR and ISAR Imaging
- ATR and Classification
- Ground and Naval
- Tracking
- Cognitive Methods
- Waveform Diversity
- Spectrum Sharing
- Electronic Warfare
- Emerging Systems
- Special Sensors
- Fully Digital Radar\*
- Machine Learning/Imaging\*
- Mobile Passive Radar\*
- Automotive Radar\*
- Dynamic Spectrum\*
- Machine Learning /Micro-Doppler\*

\* Indicates Special Session

## Tutorials

- Convex Optimization
- OTHR
- Ultra Wideband Surveillance
- Machine Learning (ATR)
- Bistatic and Multistatic
- Adaptive Array Antennas
- Adv Radar Processing Tech
- Into Synthetic Aperture Radar
- RF Convergence
- Detection, Analysis & CFAR
- Radar Systems Prototyping
- ISAR Satellite Imaging
- Tracking and Estimation
- Signal Processing
- GB Passive Radar
- Signal Processing Passive

## Conference Agenda

|                  | Mon 22                 | Tues 23                | Wed 24               | Thu 25               | Fri 26                    | Sat 27 |
|------------------|------------------------|------------------------|----------------------|----------------------|---------------------------|--------|
| <b>Morning</b>   |                        | Intro/<br>Plenary      | Technical<br>Session | Technical<br>Session | Radar<br>Summer<br>School |        |
| <b>Afternoon</b> | Tutorial<br>Session I  | Technical<br>Session   | Technical<br>Session | Technical<br>Session |                           |        |
| <b>Evening</b>   | Tutorial<br>Session II | Exhibitor<br>Reception | Banquet              |                      |                           |        |

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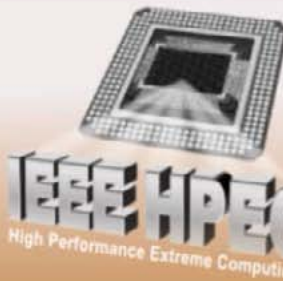
## CALL FOR PAPERS




**2019 IEEE High Performance  
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(HPEC '19)**

Twenty-third Annual HPEC Conference

24 - 26 September 2019  
Westin Hotel, Waltham, MA USA



[www.ieee-hpec.org](http://www.ieee-hpec.org)

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*The IEEE High Performance Extreme Computing Conference (HPEC '19) will be held in the Greater Boston Area, Massachusetts, USA on 24 – 26 September 2019. 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:

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Machine Learning</li> <li>Graph Analytics and Network Science</li> <li>Advanced Multicore Software Technologies</li> <li>Advanced Processor Architectures</li> <li>Automated Design Tools</li> <li>Big Data and Distributed Computing</li> <li>Case Studies and Benchmarking of Applications</li> <li>Advanced Cloud Computing</li> <li>Computing Technologies for Challenging Form Factors</li> <li>ASIC and FPGA Advances</li> </ul> | <ul style="list-style-type: none"> <li>Data Intensive Computing</li> <li>Digital Front Ends</li> <li>Fault-Tolerant Computing</li> <li>General Purpose GPU Computing</li> <li>High Performance Data Analysis</li> <li>Interactive and Real-Time Supercomputing</li> <li>Mapping and Scheduling of Parallel and Real-Time Applications</li> <li>New Application Frontiers</li> <li>Open System Architectures</li> <li>Secure Computing &amp; Anti-Tamper Technologies</li> <li>Quantum/Hybrid Computing</li> <li>AI Computing</li> </ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### HPEC accepts two types of submissions:

1. Full papers (up to 6 pages, references not included), and
2. Extended abstracts (up to 2 pages, references included).

#### IMPORTANT DATES:

Submission Deadline: **May 17, 2019**  
Notification of Acceptance: **July 1, 2019**  
Camera Ready Deadline: **August 31, 2019**

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](http://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](mailto: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.

#### 2018 Sponsors



# Practical RF PCB Design, Wireless Networks, Products and Telecommunications

**Time & Date:** 9:00AM - 4:30PM, Monday & Tuesday, April 8 & 9, 2019 **(NEW DATES!)**  
**(13 hours of instruction!)**

**Speaker:** Henry Lau, Lexiwave Technology

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Overview:** One of the most demanding consumer products in the market is the wireless telecommunication product. A well-designed Radio Frequency Printed Circuit Board (RF PCB) contributes significantly to the success of any wireless product as the layout of the PCB greatly affects the performance, stability and reliability of the product. In today's highly competitive wireless products market with increasingly compressed development time-frame, there is a strong demand for RF professionals who possess the knowledge and experience to design top-performing RF PCBs in less number of iterations. What matters is whether your level of competence is up to the required standard to meet such demand.

**Audience:** RF Designers, Wireless Product Designers, Field Application Engineers, Design Managers and related professionals.

**Benefits:** This course aims to provide participants with an insightful training on RF PCB design from a practical, industrial perspective. Participants will be led through a systematic, theoretical presentation with case studies on commercial products in the training. The course will be conducted by an RF expert with rich industrial experience. It is suitable for RF professionals who want to keep up-to-date their skills and knowledge in RF PCB design and stay competitive.

## OUTLINE

### 1. Printed circuit board design for RF circuits

From product design, circuit design to PCB design  
Layer stack-up assignment  
Grounding methods and techniques  
Interconnects and I/O  
Bypassing and decoupling  
Partitioning methods

### 2. Printed circuits board design for other circuits

Clock circuits  
Base-band circuits  
Audio circuits  
Power supplies  
Impedance-controlled circuits

### 3. PCB design for EMC/EMI compliance

EMC/EMI compliance  
Grounding methods  
Decoupling methods  
Shielding methods

### 4. Additional Design Techniques

Production concerns  
Systematic product design approach  
RF Modules  
Evaluation boards  
Other RF concerns  
Casing design

### 5. Case studies

**Expertise:**

Henry Lau received his M.Sc. and MBA degrees from UK and USA respectively. He has more than 25 years of experience in designing RF systems, products and RFICs in both Hong Kong and US. He worked for Motorola and Conexant in US as Principal Engineer on developing RFICs for cellular phone and silicon tuner applications. Mr Lau holds five patents all in RF designs. He is currently running Lexiwave Technology, a fables semiconductor company in Hong Kong and US designing and selling RFICs, RF modules and RF solutions. He has also been teaching numerous RF-related courses internationally.

*notes, lunch and coffee breaks  
included with registration*

**Decision (Run/Cancel) Date for this Courses is  
Monday, April 1, 2019**

**Payment received by March 25**

**IEEE Members \$415**

**Non-members \$445**

**Payment received after March 25**

**IEEE Members \$445**

**Non-members \$465**

<http://ieeeboston.org/practical-rf-pcb-design-wireless-networks-products-telecommunications-spring-2019/>

## 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](http://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](mailto: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.

# Software Development for Medical Device Manufacturers -

## An intensive two-day course

**Time & Date:** 8:30AM - 4:30PM, Wednesday & Thursday, April 10 & 11, 2019  
(14 hours of instruction!)

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Steve Rakitin, President, Software Quality Consulting, Inc.

### OVERVIEW

Developing software in compliance with FDA, EU regulations and international standards is challenging. This two-day intensive course provides practical guidance and suggestions for developing software that complies with applicable FDA and EU regulations, guidance documents and international standards such as IEC 62304 and ISO 14971. The focus of this course is interpreting Design Controls for software. Each section of the Design Controls regulation (820.30) is discussed from the software perspective. Corresponding requirements from IEC 62304 are woven into the flow.

In-depth discussion of critical topics such as Requirements, Software Verification & Validation, Risk Management and Fault Tree Analysis are included. In addition, techniques for validating software development tools and software used in Manufacturing and Quality Systems are also discussed. Interactive group exercises are included to facilitate discussion and learning.

### WHO SHOULD ATTEND

Software and firmware engineers, software managers, RA/QA staff, validation engineers, and project managers. Anyone interested in learning how to develop medical device software in compliance with regulations, standards and guidance documents.

### COURSE OUTLINE

#### • Introduction

- Medical Device Definitions – FDA and EU
- Regulatory Roadmap and FDA/EU Device Classification Schemes

–FDA Regulations and Guidance Documents for Software

- Standards – ISO 13485, IEC 62304, ISO 14971, EN-14971, IEC 60601, and IEC 62366-1
- All Software is Defective

- Interpreting Design Controls for Software
  - Software Development Models
  - Design and Development Planning
  - Design Inputs
    - About Requirements...
    - Requirements Exercise
  - Design Outputs
  - Design Reviews
  - Design Verification

#### • Software Verification Techniques

- Design Validation

#### • Software Validation Process

- Design Transfer
- Design Changes
- Design History File

#### • Validation of...

- Software Tools used to develop Medical Device Software
- Software used in Manufacturing
- Software used in Quality Systems

#### • Risk Management

- Standards and Regulations
- Terms and Concepts
- Risk Management Process
- Risk Management Tools and Techniques

- **Fault Tree Exercise**
  - Data Collection and Analysis
  - Documentation Requirements
- **Summary**
- **Comprehensive reference materials included**

### **Speaker Bio:**

Steven R. Rakitin has over 40 years experience as a software engineer including 25 years of experience in the medical device industry. He has worked with over 85 medical device manufacturers worldwide, from start-ups to Fortune 100 corporations. He has written several 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 and a member of MassMEDIC. He is on the

Editorial Review Board for the ASQ Journal Software Quality Professional.

As President of Software Quality Consulting Inc., he helps medical device companies comply with FDA regulations, guidance documents, and international standards in an efficient and cost-effective manner.

***notes, lunch and coffee breaks  
included with registration***

**Decision (Run/Cancel) Date for this Course is  
Monday, March 25, 2019**

#### **Payment received by March 19**

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$495</b> |
| <b>Non-members</b>  | <b>\$535</b> |

#### **Payment received after March 19**

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$535</b> |
| <b>Non-members</b>  | <b>\$565</b> |

**<http://ieeeboston.org/software-development-medical-device-manufacturers>**

### **IEEE Boston Section Social Media Links:**

**Twitter:** <https://twitter.com/ieeeboston>

**Facebook:** <https://www.facebook.com/IEEEBoston>

**YouTube:** <https://www.youtube.com/user/IEEEBostonSection>

**Google+:** <https://plus.google.com/107894868975229024384/>

**LinkedIn:** <https://www.linkedin.com/groups/IEEE-Boston-Section-3763694/about>

# The Fundamentals of Bioelectronics for Applications in Neuroprosthetics

**Time & Date:** 8:00AM - 3:00PM, Friday, April 12, 2019

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Marie Tupaj, Middlesex Community College

## Description:

This course covers the field of bioelectronics, specifically electrode design and implementation, for applications in neuroprosthetics. Electrode materials, electrode array fabrication, electrode modeling, electrical stimulation parameters, bioelectrode charge transfer mechanisms, and interfaces with biological systems are discussed. The fundamental theories of electromagnetism and a history of bioelectromagnetics are reviewed.

## Target Audience:

This class is designed for engineers transitioning into the field of bioelectronics, electronics engineers interested in neurobiology, and professionals looking for an understanding of bioelectronics to complete their job function.

## Outline

### **Module #1: Electromagnetics in Biological Systems**

The first lecture will identify and describe electromagnetic fields in biology then explain the effects of electric fields when applied to biological tissue and living systems. Topics covered include: Maxwell's Equations, history of bioelectromagnetics, biological effects (tissue growth, regeneration, cell communication) and biological mechanisms (action potentials, impulse propagation, ion channel and receptor activation) of electrical stimulation, and charge transfer to biological systems.

### **Module #2: Bioelectronics: Electrode Materials, Design, and Fabrication**

The second lecture will discuss electrode materials, electrode configurations, and electrode fabrication

techniques. Topics include: key electrode properties (biocompatibility, mechanics, surface chemistry, charge transfer), common electrode materials (gold, platinum, titanium, carbon, PEDOT), electrode substrates, electrode configurations (capacitors, coils, microelectrode arrays), microelectrode array structure, electrode arrays (microwires, polymer arrays), and electrode micro-fabrication techniques (photolithography, sputtering).

### **Module #3: Bioelectronics: Electrode Characterization and Testing**

Topics of this lecture include: electrode characterization techniques (impedance, wettability, roughness, conductivity, thickness, composition, mechanical integrity), and electrode rejuvenation.

### **Module #4: Bioelectronics: Electrode Modeling, Stimulation, and Devices**

Topics include: electrode modeling with COMSOL, stimulation regimens (pulse shape, location, duration), field strength, stimulation devices (inductively coupled, capacitively coupled, microelectrode array systems), neurotransmission, and neural recordings (local field potentials, noise).

### **Module #5: Neuroprosthetic Implantation and Biological Interfaces**

The last lecture discusses electrode implantation, applications, and use. Topics include: clinical background, nervous system anatomy, neuroprosthetic devices (retinal prosthetics, auditory implants, nerve guides, vagus nerve stimulation, TEMS, EEG, ECoG, limb prosthetics), neuroprosthetic-tissue interfaces, design require-

ments, short term and long term cell-tissue responses, electrode sterilization techniques, and device/patient safety.

### Upon Completion of This Course You Will:

- Understand the effects of electric fields on cells and the optimal parameters for a biological response
- Learn bioelectrode design and fabrication techniques
- Understand key challenges in designing neuro-prosthetic devices

### About the Instructor:

Marie Tupaj is a biomedical scientist and engineer with 10 years' experience in biomaterials, bioelectronics, and nerve cell biology. Marie has a B.S. in electrical engineering and a Ph.D. in biomedical engineering from Tufts University. As a doctoral student, Marie designed electrodes for encouraging nervous tissue development and developed silk based biomaterial conduits for peripheral nerve regeneration. These projects were supported by the NIH and the Armed Forces Institute of

Regenerative Medicine. As a postdoctoral fellow, Marie fabricated miniaturized biosensors and chemically modified surfaces for applications in the field of neuro-prosthetics. Marie has worked at high tech and biotech companies in the Boston area including Sun Microsystems, Organogenesis, and Histogenics Corporation. She is currently an Assistant Professor at Middlesex Community College in Bedford, MA.

***notes, lunch and coffee breaks  
included with registration***

**Decision (Run/Cancel) Date for this Courses is  
Friday, April 5**

### Payment received by March 29

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$225</b> |
| <b>Non-members</b>  | <b>\$250</b> |

### Payment received after March 29

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$250</b> |
| <b>Non-members</b>  | <b>\$275</b> |

**<http://ieeeboston.org/fundamentals-of-bioelectronics-for-applications-in-neuroprosthetics/>**

## Call for Course Speakers/Organizers

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- 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.

**Last Notice Before Courses Begins, Please Register Now!!!**

# Python Applications for Digital Design and Signal Processing

(11 hours of instruction!)

**Time & Date:** 6:00 - 9:00PM, Wednesdays, March 6, 13, 20, 27

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

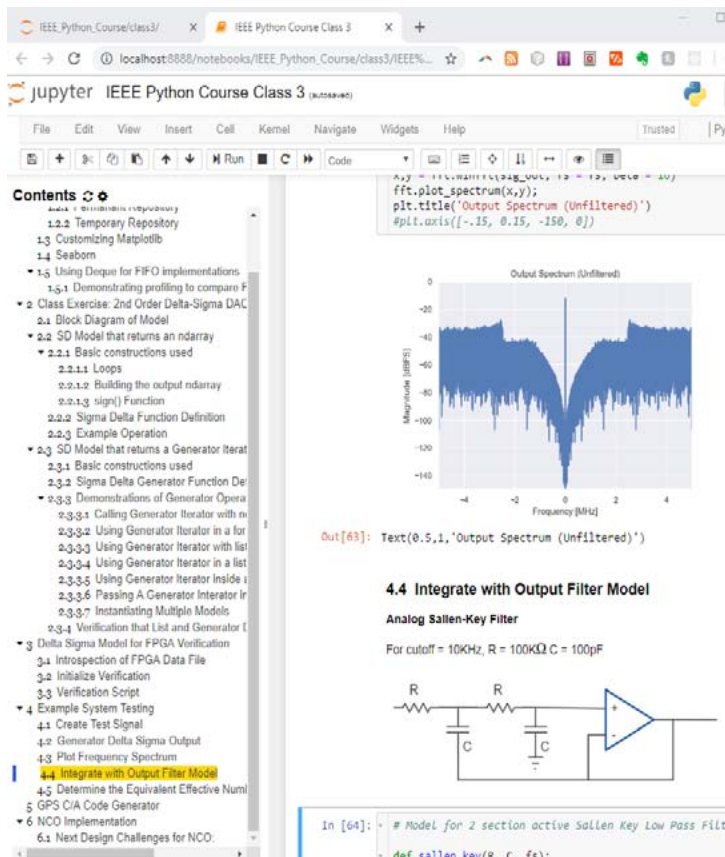
**Speaker:** Dan Boschen

## Course Summary

This is a bring-your-own laptop, hands-on course in the popular and powerful open source Python programming language. Dan provides simple, straight-forward navigation through the multiple configurations and options, providing a best-practices approach for quickly getting up to speed using Python for solving signal processing challenges. Students will be using the Anaconda distri-

bution, which combines Python with the most popular data science applications, and the Jupyter Notebooks for a rich, interactive experience.

The course begins with basic Python data structures and constructs, including key “Pythonic” concepts, followed by an overview and use of popular packages for scientific computing enabling rapid prototyping for system design. Once a basic working knowledge of the language is established, students will create example designs including a sigma delta converter and direct digital synthesizer both in floating point and fixed point. This will include considerations for cycle and bit accurate models useful for digital design verification (FPGA/ASIC), while bringing forward the signal processing tools for frequency and time domain analysis.



## Jupyter Notebooks

This course makes extensive use of Jupyter Notebooks which combines running Python code with interactive plots and graphics for a rich user experience.

Jupyter Notebooks is an open-source web based application (that can be run locally) that allows users to create and share visually appealing documents containing code, graphics, visualizations and interactive plots.

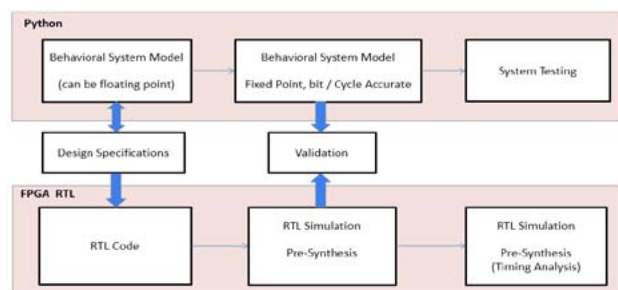
Students will be able to interact with the notebook contents and use “take-it-with-you” results for future applications in signal processing.

## Target Audience:

This course is targeted toward users with little to no prior experience in Python, however familiarity with other

modern programming languages and an exposure to object-oriented constructs is very helpful. Students should be comfortable with basic signal processing concepts in the frequency and time domain. Familiarity in Matlab or Octave is not required, but the equivalent operations in Python using the NumPy package will be provided for those students that do use Matlab and/or Octave for signal processing applications.

## Python for Verification



A laptop (Mac or PC) preconfigured with Anaconda is required; the specific installation instructions will be emailed to students prior to the start of class.

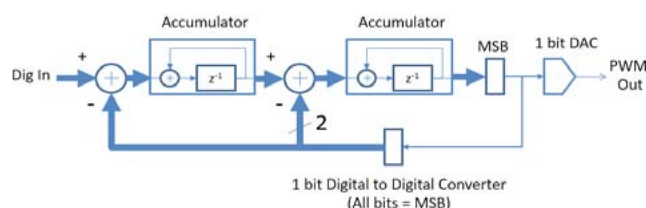
### Benefits of Attending/ Goals of Course:

Each student that completes the course will have the tools in place to immediately put Python to use in their current work environment for scientific computing applications. After this course, you will love using Python as much as Dan does!

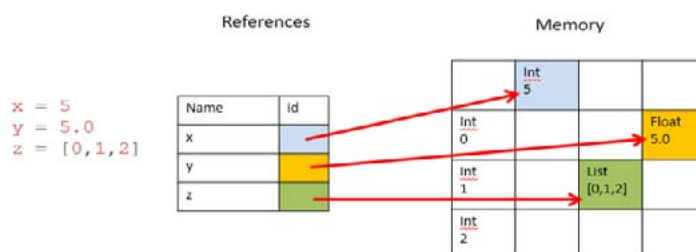
### Topics / Schedule:

**Class 1: Intro to Jupyter Notebooks, the Spyder IDE and the course design examples including Delta Sigma Converters, GPS Code Generators, and Numerically Controlled Oscillators. Core Python constructs.**

## 2<sup>nd</sup> Order Delta Sigma DAC



## Mutable / Immutable



**Class 2: Core Python constructs, functions, reading writing data files.**

**Class 3: Signal processing simulation with popular packages including NumPy, SciPy, and Matplotlib.**

**Class 4: Bit/cycle accurate modelling and analysis using the design examples and simulation packages.**

**Speaker's Bio:** Dan Boschen has a MS in Communications and Signal Processing from Northeastern University, with over 20 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 Symmettricom) 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 Courses is Wednesday, February 27**

**Payment received by Feb. 20**

**IEEE Members \$325**  
**Non-members \$350**

**Payment received after Feb. 20**

**IEEE Members \$350**  
**Non-members \$375**

<http://ieeeboston.org/python-for-signal-processing/>

# DSP for Wireless Communications

(13 hours of instruction!)

**Time & Date:** 6:00 - 9:00PM, Tuesdays, April 9, 16, 23, 30, May 7

**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Dan Boschen

## Course Summary:

This course is a fresh view of the fundamental 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”.

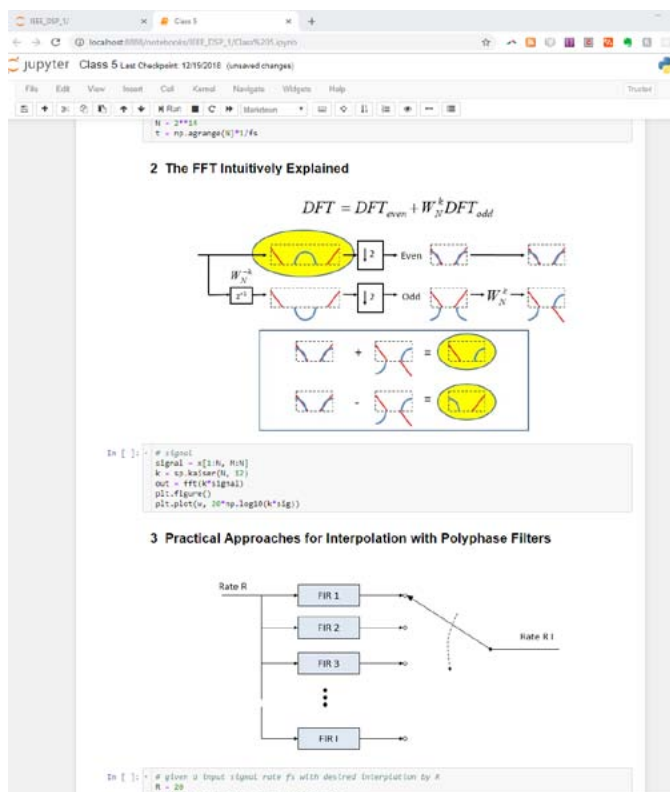
Students will be encouraged but not required to bring a laptop to class, and all set-up information for installation will be provided prior to the start of class.

## Target Audience:

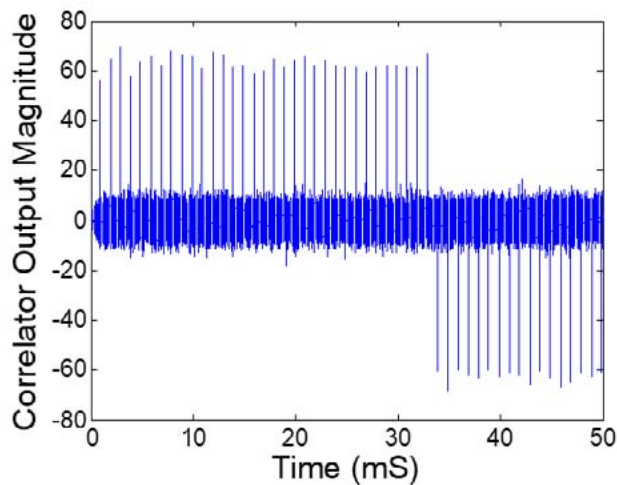
All engineers involved in or interested in signal processing applications. Engineers with significant experience with DSP will also appreciate this opportunity for an in-depth review of the fundamental DSP concepts from a different perspective than that given in a traditional introductory DSP course.

## Benefits of Attending/ Goals of Course:

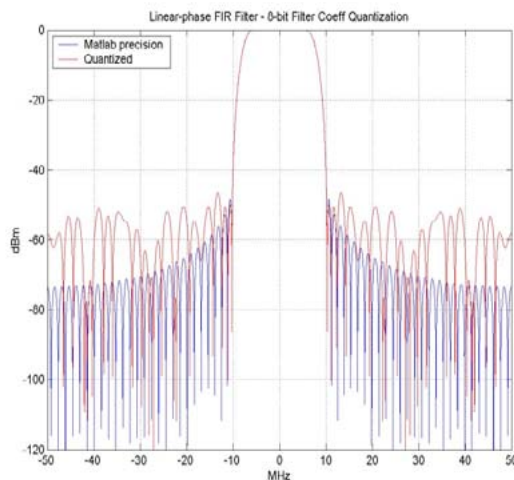
Attendees will build a stronger intuitive understanding of the fundamental signal processing concepts involved with digital filtering and mixed signal analog and digital design. With this, attendees will be able to implement more creative and efficient signal processing architectures in both the analog and digital domains.



## Sliding Correlation



## Linear Phase FIR Filter (8-bit quantized filter coefficients)

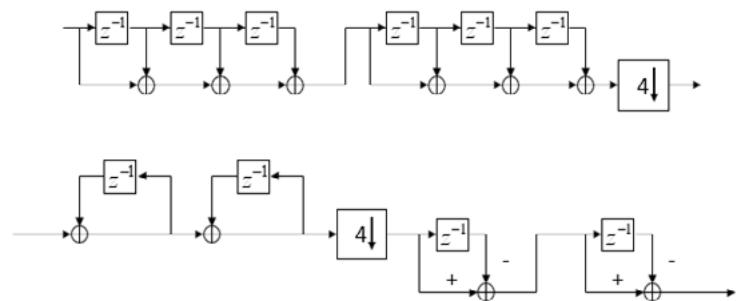


## Class 5: Fast Fourier Transform, Multi-rate Signal Processing, Multi-rate Filters

### 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

## Multi-stage CIC



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>

### 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**

**Decision (Run/Cancel) Date for this Courses is Tuesday, April 2**

**Payment received by March 26**

**IEEE Members \$350**

**Non-members \$385**

**Payment received after March 26**

**IEEE Members \$385**

**Non-members \$420**

# DSP for Software Radio

(13 hours of instruction!)

**Time & Date:** 6:00 - 9:00PM, Wednesdays, May 15, 22, 29, June 5, 12

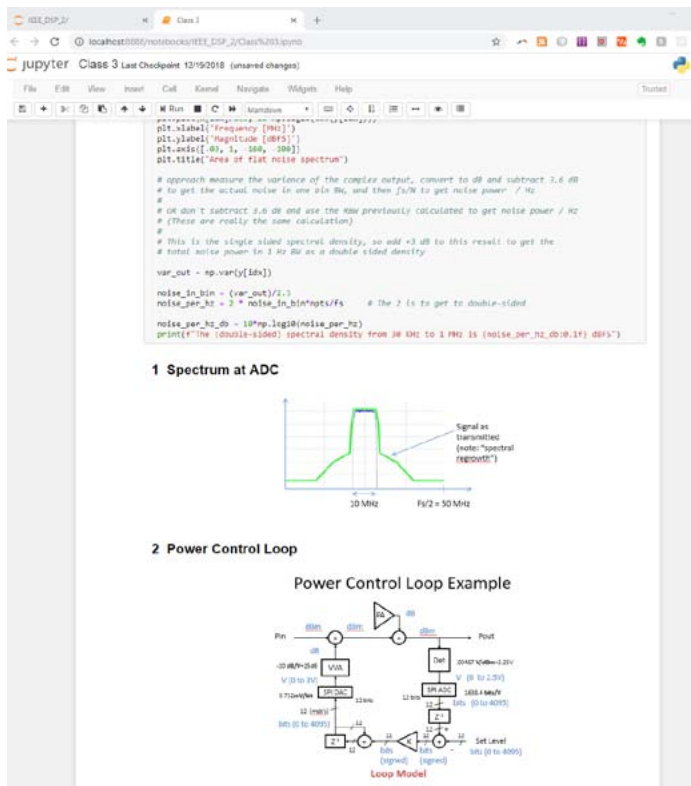
**Location:** Crowne Plaza Hotel, 15 Middlesex Canal Park Road, Woburn, MA

**Speaker:** Dan Boschen

## Course Summary

This course builds on the IEEE course “DSP for Wireless Communications” also taught by Dan Boschen, further detailing digital signal processing most applicable to practical real-world problems and applications in radio communication systems. Students need not have taken the prior course if they are familiar with fundamental DSP concepts such as the Laplace and Z transform

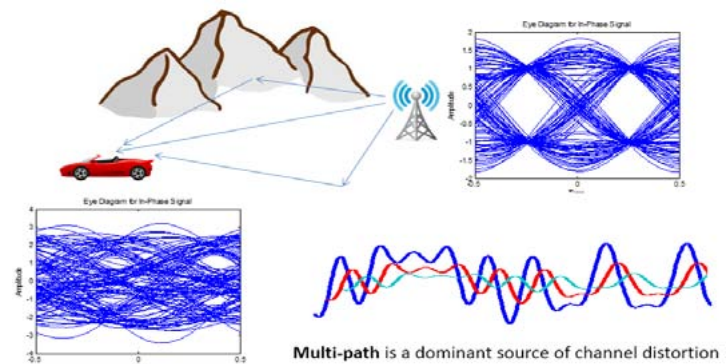
radios and modems for modern wireless communications. Specific areas covered include carrier and timing recovery, equalization, automatic gain control, and



and basic digital filter design principles. The course title has been changed with some minor additions but this is the same course that was previously taught titled “More DSP for Wireless Communications”, with the addition of Python demonstrations using Jupyter Notebooks.

This course brings together core DSP concepts to address signal processing challenges encountered in

## Channel Distortion



considerations to mitigate the effects of RF and channel distortions such as multipath, phase noise and amplitude/phase offsets.

Dan builds an intuitive understanding of the underlying mathematics through the use of graphics, visual demonstrations, and real-world applications for mixed signal (analog/digital) modern transceivers. This course is applicable to DSP algorithm development with a focus on meeting practical hardware development challenges, rather than a tutorial on implementations with DSP processors.

## 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

### Benefits of Attending/ Goals of Course:

Attendees will gain a strong intuitive understanding of the practical and common signal processing implementations found in modern radio and modem architectures and be able to apply these concepts directly to communications system design.

### Topics / Schedule:

**Class 1: DSP Review, Radio Architectures, Digital Mapping, Pulse Shaping, Eye Diagrams**

**Class 2: ADC Receiver, CORDIC Rotator, Digital Down Converters, Numerically Controlled Oscillators**

**Class 3: Digital Control Loops; Output Power Control, Automatic Gain Control**

**Class 4: Digital Control Loops; Carrier and Timing Recovery, Sigma Delta Converters**

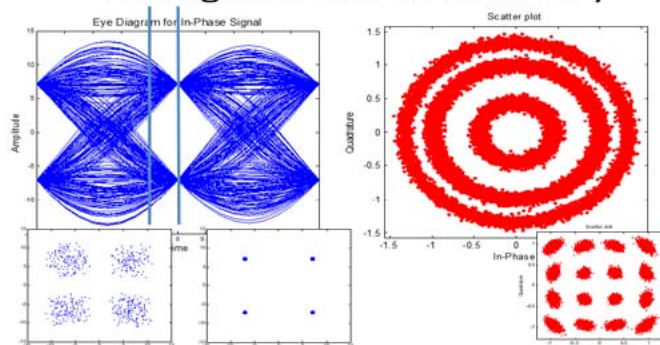
**Class 5: RF Signal Impairments, Equalization and Compensation, Linear Feedback Shift Registers**

### 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>

## Timing and Carrier Recovery



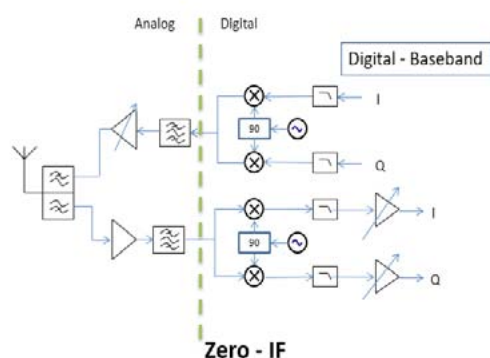
is covered in a separate IEEE Course "Python Applications for Digital Design and Signal Processing".

Students will be encouraged but not required to bring a laptop to class, 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 for wireless communications. Students should have either taken the earlier course "DSP for Wireless Communications" or have been sufficiently exposed to basic signal processing concepts such as Fourier, Laplace,

## Radio Architectures



and Z-transforms, Digital filter (FIR/IIR) structures, and representation of complex digital and analog signals in the time and frequency domains. Please contact Dan at [boschen@loglin.com](mailto:boschen@loglin.com) if you are uncertain about your background or if you would like more information on the course.

**Decision (Run/Cancel) Date for this Courses is Wednesday, May 8**

### Payment received by May 1

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$340</b> |
| <b>Non-members</b>  | <b>\$375</b> |

### Payment received after May 1

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$375</b> |
| <b>Non-members</b>  | <b>\$440</b> |

# Fundamentals of Real-Time Operating Systems (*Online Edition*)

***Students have access to this self-paced course for 90 days!!***

***Registration Fee: \$350***

**Course Summary** - This course introduces the basics of Real-Time Operating Systems (RTOSes) using VxWorks and Linux as examples. The course focuses on the primary principles of RTOSes including determinism, real-time scheduling, interrupt latency and fast context switching as well as time and space partitioning in hard real-time environments. The first part of the course focuses on acquiring an understanding of microkernel and memory architectures for Real-Time including scheduling, signals, system calls, synchronization, inter-process communications and interrupt handling. The latter part of the course covers considerations for timing, memory management, device drivers, booting, debugging and deployment of Real-Time embedded systems.

**Who Should Attend** - The course is designed for real-time engineers who are using or intending to use a Real-Time Operating System. It is also targeted at experienced developers requiring a refresher course on RTOSes. This course will clearly demonstrate both the strengths and weaknesses of Real-Time Operating Systems used in Embedded Systems.

## **Course Objectives**

- To provide a basic understanding of Real-Time Requirements and Design Decisions
- To understand the complexities of RTOS scheduling and synchronization
- To learn how to configure, boot, test and deploy Real-Time embedded systems
- To give students the confidence to apply these concepts to their next RTOS project

**Lecturer** – Mike McCullough is President and CEO of

RTETC, LLC. Mike has a BS in Computer Engineering and an MS in Systems Engineering from Boston University. He has held a variety of software engineering positions at LynuxWorks, Embedded Planet, Wind River Systems and Lockheed Sanders. RTETC, LLC provides Real-Time embedded training and consulting to many embedded systems companies. RTETC focuses on Real-Time operating systems (RTOS), Linux and Android solutions for the embedded systems market.

**Hardware and Software Requirements** - The student should have a working Linux desktop environment either directly installed or in a virtualization environment or have access to a development environment for a Real-Time Operating System such as VxWorks. An Embedded Linux or VxWorks target hardware platform is useful but not absolutely required for this course.

## **Embedded Development Basics**

Embedded Systems Characteristics  
Embedded Real-Time Systems  
Real-Time Enough  
Embedded Linux and Real-Time

## **Real-Time Operating System Basics**

Microkernel Architecture  
Microkernel Scheduling  
Determinism  
Rate Monotonic Analysis and Fixed Priority Scheduling  
Latency and Latency Measurements  
Fast Context Switching  
Real-Time Memory Architectures  
Time and Space Partitioning and ARINC  
Multiprocessor Basics  
Amdahl's Law

## **RTOS Kernel Overview**

Real-Time Scheduling and Task Management  
Signals and System Calls  
Synchronization

Inter-Process Communications (IPC)  
 Interrupt Handling  
 Error Handling  
 Timing and Timers  
 Real-Time Memory Management

## **Real-Time Scheduling**

OS Scheduling Types  
 Pre-emptive Multitasking  
 Typical Scheduling Issues  
 Linux Scheduling  
 VxWorks Scheduling  
 VxWorks Tasks  
 VxWorks Real-Time Processes (RTPs)  
 Linux Threads  
 Task and Thread-Specific Data (TSD)  
 Measuring Task and Thread Performance

## **Signals in Embedded RTOSes**

## **System Calls in Embedded RTOSes**

### **Synchronization**

Via Global Data  
 Via Semaphores, Files and Signals  
 Condition and Completion Variables in Linux  
 Mutexes in VxWorks and Linux  
 Linux Futexes  
 Software Watchdog Timers

### **Inter-Process Communications (IPC)**

More Semaphores  
 Message Queues  
 Shared Memory  
 Pipes and FIFOs  
 Remote Procedure Calls  
 Networking

### **Interrupts and Exception Handling**

Basic Interrupt Process  
 VxWorks intLib and exLib  
 Routines You Can Call From Interrupt Context

### **Interrupt Service Routines (ISRs)**

VxWorks and Linux ISRs

## **Bottom Halves in Linux**

## **Deferring Work**

Tasklets and Work Queues in Linux  
 Helper Tasks

### **Error Handling**

Error Handling Approaches in OS Design

### **Error Handling in VxWorks**

Error Handling in Tasks and Interrupts  
 Error Number Format  
 Using errnoSet, errnoGet and printErrno  
 Creating Your Own Errors

### **Error Handling in Linux**

Standard Error Defines  
 errno and perror  
 strerror and strerror\_r  
 Resets, OOPS, Panics and Segmentation Faults

### **Error Logging Approaches**

### **Timing and Timers**

How RTOSes Tell Time  
 VxWorks tickLib and timerLib  
 Linux Kernel, POSIX and Interval Timers  
 Linux High-Resolution Timers (HRTs)  
 VxWorks taskDelay  
 Linux Sleeping, Sleep Waiting and Spinlocks  
 VxWorks Watchdog Timers (wdLib)  
 Periodic Execution Example  
 Deadline Miss Detection  
 Embedded Recommendations for Timing

### **Memory Management and Paging**

The VxWorks Memory Model  
 Real-Time Memory Algorithms  
 VxWorks memLib and memPartLib  
 Linux, Memory and Demand Paging  
 Mapping Device Memory in Linux  
 The Slab Allocators in Linux  
 The Linux /proc Filesystem  
 Memory Barriers  
 The Linux OOM Killer  
 Reserving and Locking Memory  
 Memory in Embedded Systems

### **Device Drivers in VxWorks**

File Descriptors  
 The VxWorks IO Subsystem  
 VxWorks ioLib, fioLib and iosLib

## **The 5 Basic Device Driver Types**

Char, Block and Network Drivers  
Virtual Drivers and Basic I/O Drivers  
Other Device Drivers  
The VxBus in VxWorks

## **Device Drivers in Linux**

File Descriptors in Linux  
The UNIX Device Driver Model  
Major and Minor Numbers  
The New Device Driver Model

## **The VxWorks Boot Process**

VxWorks Boot Example  
Configuration Files  
Application Startup  
VxWorks 7

## **The Linux Boot Process**

The Root Filesystem in Linux  
Bootloaders and U-Boot  
Configuring Linux  
Embedded Linux Boot Methods  
Building and Booting from SD Cards and eMMC  
Yocto and Poky

## **Debugging Basics**

How Software Debuggers Work  
Debuggers and Intrusion  
Types of Debugging Approaches  
Process-Level vs System-Level Debug

## **Process-Level Debug**

GDB, GDB Server and the GDB Server Debugger  
The VxWorks Debug Agent (WDB)  
Other Debug Tools for Linux and VxWorks  
A Remote Debug Example  
Printing and Logging

## **System-Level Debug**

LTTng and the VxWorks Systems Viewer (Windview)  
System-Level Debug Tools  
The /proc and /sys Virtual Filesystems in Linux  
Linux Kernel Debug  
Linux Crash Dumps

## **Deploying VxWorks Systems**

VxWorks Systems Customization and Configuration  
VxWorks Field Upgrades

## **Deploying Embedded Linux Systems**

Linux Systems Customization and Configuration  
Choosing and Building the Root Filesystem  
Module Decisions  
Final IT Work  
Final deployment of Embedded Linux Field Systems

## **RTOS Trends**

## **Some Final Recommendations**

Getting Help  
Measuring Performance  
Managing Memory  
Things To Remember

<http://ieeeboston.org/fundamentals-of-real-time-operating-systems-rt201-on-line-course/>

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**LinkedIn:** <https://www.linkedin.com/groups/IEEE-Boston-Section-3763694/about>

# Embedded Linux Board Support Packages and Device Drivers *(Online Edition)*

***Students have access to this self-paced course for 90 days!!***

***Registration Fee: \$350***

**Course Summary** - This video course provides advanced training in the development of Embedded Linux Board Support Packages (BSPs) and Device Drivers. The first part of the course focuses on BSP and Software Development Kit (SDK) development in an Embedded Linux context with a focus on application performance measurement and improvement. The latter part of the course covers Embedded Linux Device Driver development including key device driver decisions and deployment considerations for Embedded Linux BSPs.

**Who Should Attend** - The course is designed for real-time engineers who are developing Embedded Linux BSPs and Device Drivers for Embedded Linux distributions. It is also targeted at experienced developers requiring a refresher course on Linux BSP and Device Driver development.

## **Course Objectives**

- To gain an understanding of the complexities of BSP and SDK development and their uses in Embedded Linux systems.
- To provide a basic understanding of the Linux I/O Subsystem and the Device Driver Models provided with Embedded Linux distributions.
- To gain an in-depth understanding of character-based device drivers in Embedded Linux
- To understand key device driver subsystems including relatively slow I/O interconnects such as I2C, SPI and USB as well as high-speed interfaces such as Ethernet, USB 3.0 and PCIe

- To give students the confidence to apply these concepts to their next Embedded Linux project.

**Lecturer** – Mike McCullough is President and CEO of RTETC, LLC. Mike has a BS in Computer Engineering and an MS in Systems Engineering from Boston University. A 20-year electronics veteran, he has held various positions at LynuxWorks, Tilera, Embedded Planet, Wind River Systems, Lockheed Sanders, Stratus Computer and Apollo Computer. RTETC, LLC is a provider of Eclipse-based software development tools, training and consulting services for the embedded systems market.

## **Course Schedule**

Getting Started with Embedded Linux

Embedded Linux Training Overview  
Linux Terminology, History and the GPL  
Building the Kernel Source Code  
Embedded Linux Kernels  
BSPs and SDKs

Linux References (Books and Online)

BSP Requirements

U-Boot and Bootloader Development

Embedded Linux BSP Development Basics

Basic BSP Development

Files and Filesystem Support

The I/O Subsystem: Talking to Hardware

Memory Management and Paging

Error Handling in Embedded Linux BSPs

Timing and Timers

Interrupt and Exception Handling in BSPs

BSP Deployment Issues and Practices

Embedded Linux SDK Basics

The 3 Pieces of an SDK

Embedded Linux Distributions and the GNU Compiler

---

|                                             |                                           |
|---------------------------------------------|-------------------------------------------|
| Collection (GCC)                            | BootLoader Optimizations                  |
| Other Embedded Linux Development Tools      | Boot Time Measurements                    |
| Library Support, Glibc and Alternatives     | Effective Memory and Flash Usage          |
| SDK Deployment and Support                  | Filesystem Performance Measurement        |
| Debugging                                   | Some Ideas on Performance Measurement     |
| GDB, GDB Server and the GDB Server Debugger |                                           |
| Other Debug and Test Tools                  | The Original UNIX Device Driver Model     |
| An Eclipse Remote Debug Example             | The fops and file structs                 |
| Advanced Debug with printk and syslogd      | The inode and dentry structs              |
| System-Level Debug                          | Major and Minor Numbers                   |
| System-Level Debug Tools                    | Embedding Channel Information             |
| The /proc and sys Filesystems               | Deferring Work                            |
| Advanced Logging Methods                    | The /proc Filesystem                      |
| KGDB and KDB                                | Configuring the Device Driver             |
| Crash Dumps                                 | A Simulated Device Driver                 |
| Debugging Embedded Linux Systems            | Modularization Revisited                  |
| Configuring Embedded Linux                  | The Evolution of a New Driver Model       |
| Config Methods                              | The Initial Object-Oriented Approach      |
| Config Syntax                               | Platform Devices and Drivers              |
| Adding Code to the Linux Kernel             | A Generic Subsystem Model                 |
| Booting Embedded Linux                      | The Generic Subsystem Model in Detail     |
| Processor Startup                           | Subsystem Registration                    |
| Initial Functions                           | The Probe and Init Functions              |
| The initcalls                               | The Show and Store Functions              |
| Using __init Functions                      | User Access via the /sys Filesystem       |
| NFS Booting                                 | Configuring the New Device Driver         |
| Root File Systems                           | The udev Linux Application                |
| RAMdisk Booting with initrd                 | Comparing the Two Driver Models           |
| RAMdisk Booting with initramfs              | The Flattened Device Tree (FDT)           |
| initrd vs initramfs                         | openBoot and its Effect on Embedded Linux |
| Root File System Development                | The Device Tree Script (dts) File         |
| Busybox Development                         | The Device Tree Compiler (dtc)            |
| Building a RAMdisk for an initrd            | The Device Tree Blob (dtb) File           |
| Building a RAMdisk for an initramfs         | Building a dtb File                       |
| Flash File System Development               | Hybrid Device Drivers                     |
|                                             | Other fops Functions                      |
| Testing and Debug of Embedded Linux BSPs    | The Need for ioctl                        |
| Kernel Debug and Kernel Probes              | Linux Device Driver Subsystems            |
| Kexec and Kdump                             | Direct Connect Device Drivers             |
| The Linux Test Project (LTP)                | Serial/Console Drivers, I2C & SPI         |
| Performance Tuning Embedded Linux BSPs      | Real-Time Clocks and Watchdogs            |
| Virtualization                              | GPIO and the Pinmux                       |
| Measuring Embedded Linux BSP Performance    | Flash MTDs and Direct Memory Access       |
| Common Considerations                       | USB, Power and CPU Management             |
| Uncommon Considerations                     | Video and Audio                           |

PCI and VME  
 Block Devices  
 RAMdisk and Flash Filesystems  
 MMCs and SD Cards  
 Network Device Drivers  
 MAC and PHY Device Drivers  
 net\_device and net\_device\_stats  
 Network Device Initialization  
 Device Discovery and Dynamic Initialization  
 Network Interface Registration  
 Network Interface Service Functions  
 Receiving and Transmitting Packets  
 Notifier Chains and Device Status Notification  
 Unwired Device Drivers  
 Wireless Device Drivers (WiFi, WLAN)  
 Bluetooth and BlueZ  
 Infrared and IrDA  
 Cellular from 2G to 5G

Drivers in User Space  
 Accessing I/O and Memory Regions  
 User Mode SCSI, USB and I2C  
 UIO  
 High-Speed Interconnects  
 PCIe  
 iSCSI  
 Infiniband  
 FibreChannel  
 Debugging Device Drivers  
 kdb, kgdb and JTAG  
 Kernel Probes  
 Kexec and Kdump  
 Kernel Profiling  
 User Mode Linux  
 Performance Tuning Device Drivers  
 Some Final Recommendations

<http://ieeeboston.org/embedded-linux-bsps-device-drivers-line-course/>

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# Embedded Linux Optimization - Tools and Techniques (*Online Edition*)

***Students have access to this self-paced course for 90 days!!***

***Registration fee: \$250***

**Summary** - This video course provides advanced training in the debugging, testing, profiling and performance optimization of Embedded Linux software. The first part of the course focuses on advanced debugging, testing and profiling in an Embedded Linux context with a focus on using Eclipse, Backend Debuggers, JTAG and In-Circuit Emulators as well as Kernel Logging capabilities and Kernel Hacking. The latter part of the course covers performance measurement and optimization affecting boot, memory, I/O and CPU performance and key performance optimization tools for Embedded Linux software including the perf tool, advanced cache usage and compiler-based optimization.

**Who Should Attend** - The course is designed for real-time engineers who are developing high-performance Linux applications and device drivers using Embedded Linux distributions. It is also targeted at experienced developers requiring a refresher course on Advanced Embedded Linux optimization.

## **Course Objectives**

- To understand debugging, profiling and testing high performance Embedded Linux software.
- To provide an overview of Linux application performance measurement and optimization.
- To understand the tools used for performance optimization of Embedded Linux software.

- To give students the confidence to apply these concepts to their next Embedded Linux project.

**Lecturer** – Mike McCullough is President and CEO of RTETC, LLC. Mike has a BS in Computer Engineering and an MS in Systems Engineering from Boston University. He has held a variety of software engineering positions at LynuxWorks, Embedded Planet, Wind River Systems and Lockheed Sanders. RTETC, LLC provides real-time embedded training and consulting to many embedded systems companies. RTETC focuses on real-time operating systems (RTOS), Linux and Android solutions for the embedded systems market.

Getting Started with Embedded Linux

Embedded Linux Training Overview

Terminology

Linux Versioning

The GPL

Building the Kernel Source Code

Embedded Linux Kernels

BSPs and SDKs

Linux References (Books and Online)

A Development Cycle Focused on Performance

A Basic Optimization Process

Basic Debugging Review

Embedded Applications Debug

GDB, GDB Server and the GDB Server Debugger

Other Debuggers

An Eclipse Remote Debug Example

Debugging with printk, syslog, syslogd and LTTng

System-Level Debug

System-Level Debug Tools

The /proc and /sys Filesystems

|                                                 |                                            |
|-------------------------------------------------|--------------------------------------------|
| Basic Logging                                   | New Tracing Methods                        |
| KDB and KGDB                                    | SystemTap                                  |
| Crash Dumps and Post-Mortem Debugging           | Ftrace, Tracepoints and Event Tracing      |
| Debugging Embedded Linux Systems                | Tracehooks and utrace                      |
| Backend Debuggers                               | Profiling                                  |
| In-Circuit Emulators                            | Basic Profiling                            |
| Hardware Simulators                             | gprof and Oprofile                         |
| Analyzers                                       | Performance Counters                       |
| Requirements Development                        | LTTng                                      |
| Performance Requirements                        | Another DDD Example                        |
| Derived Requirements                            | Manual Profiling                           |
| Testability and Traceability                    | Instrumenting Code                         |
| Reviewing Requirements                          | Output Profiling                           |
| Designing for Performance                       | Timestamping                               |
| Design for Test (DFT)                           | Addressing Performance Problems            |
| Agile Software Design                           | Types of Performance Problems              |
| Software and Linux Decomposition                | Using Performance Tools to Find Areas for  |
| Memory Management                               | Improvement                                |
| CPU and OS Partitioning                         | Application and System Optimization        |
| Design Reviews                                  | CPU Usage Optimization                     |
| Coding for Performance                          | Memory Usage Optimization                  |
| Coding Standards and Consistency                | Disk I/O and Filesystem Usage Optimization |
| Languages, Libraries and Open Source Components | Measuring Embedded Linux Performance       |
| Learning Magic Numbers                          | Some Ideas on Performance Measurement      |
| Letting Compilers Work For You                  | Common Considerations                      |
| Global, Static and Local Variables              | Uncommon Considerations                    |
| Code Reviews                                    | Using JTAG Methods                         |
|                                                 | BootLoader Measurements                    |
| Software Testing                                | Boot Time Measurements                     |
| Unit-Level Testing                              | The Perf Tool                              |
| System-Level Testing                            | Origins of Perf                            |
| Code Coverage Tools                             | The Perf Framework                         |
| gcov                                            | Perf Commands and Using Perf               |
| Automated Testing                               | Listing Events                             |
| Some Embedded Linux Test Recommendations        | Counting Events                            |
| DebugFS                                         | Profiling with Perf                        |
| Configuring DebugFS                             | Static Tracing with Perf                   |
| DebugFS Capabilities                            | Dynamic Tracing with Perf                  |
| Advanced Logging                                | Perf Reporting                             |
| LogFS                                           | Performance Tool Assistance                |
| Using Logwatch and Swatch                       | Recording Commands and Performance         |
| Using syslogd and syslog-ng                     | System Error Messages and Event Logging    |
| Tracing                                         | Dynamic Probes                             |
| ptrace and strace                               | Jprobes and Return Probes                  |
|                                                 | Kernel Probes                              |

## Kexec and Kdump

- Improving Boot Performance
- Boot Time Optimization
- The Linux Fastboot Capability
- Building a Smaller Linux
- Building a Smaller Application
- Filesystem Tips and Tricks
- Some Notes on Library Usage
- Improving Kernel Performance

## Kernel Hacking

CONFIG\_EMBEDDED

Configuring printk

Test Code

Configuring Kernel and IO Scheduling

Improving CPU Performance

Run Queue Statistics

Context Switches and Interrupts

CPU Utilization

Linux Performance Tools for CPU

Process-Specific CPU Performance Tools

Stupid Cache Tricks

Improving System Memory Performance

Memory Performance Statistics

Linux Performance Tools for Memory

Process-Specific Memory Performance Tools

More Stupid Cache Tricks

Improving I/O and Device Driver Performance

Disk, Flash and General File I/O

Improving Overall Performance Using the Compiler

Basic Compiler Optimizations

Architecture-Dependent and Independent Optimization

Code Modification Optimizations

Feedback Based Optimization

Application Resource Optimization

The Hazard of Trust

An Iterative Process for Optimization

Improving Development Efficiency

The Future of Linux Performance Tools

Some Final Recommendations

<http://ieeeboston.org/embedded-linux-optimization-tools-techniques-line-course/>

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# Software Development for Medical Device Manufacturers (Online Edition)

**Students have access to this self-paced course for 90 days!! Registration Fee : \$125**

**Course Description** This course provides an introduction to the development of medical device software. The course is comprised of 4 modules that range from 30-45 minutes in duration. The focus is on complying with FDA Design Controls and IEC 62304 requirements.

This course is intended for software developers who are actively involved in developing medical device software.

## Module 1

- Medical Device Definitions: FDA and European Union (EU)
- Regulatory Roadmap
- FDA/EU Device Classifications
- FDA QSR Regulation
- FDA Guidance Documents that pertain to medical device software

## Module 2

- International Standards that pertain to medical device software
- Types of Software Regulated by FDA
- Quality System basics: Procedures, Work Instructions and Records
- ALL Software is Defective...

## Module 3:

- Design Control Overview
- General Requirements
- Design and Development Planning
- Software Development Models
- Design Input
- About Requirements...
- Design Output

- Design Reviews

## Module 4:

- Design Control (continued)
- Design Verification
- Software Verification Process
- Testing Overview
- Design Validation
- Software Validation Process
- Design Changes
- Design Transfer
- Design History File
- Course Summary

## **Speaker Bio:**

Steven R. Rakitin has over 40 years experience as a software engineer including 25 years of experience in the medical device industry. He has worked with over 85 medical device manufacturers worldwide, from startups to Fortune 100 corporations. He has written several 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 and a member of MassMEDIC. He is on the Editorial Review Board for the ASQ Journal Software Quality Professional.

As President of Software Quality Consulting Inc., he helps medical device companies comply with FDA regulations, guidance documents, and international standards in an efficient and cost-effective manner.

<http://ieeeboston.org/software-development-medical-device-manufacturers-line-course/>

# Fundamental Mathematics Concepts

## Relating to Electromagnetics (*Online Edition*)

***Students have access to this self-paced course for 90 days!!***

***Registration Fee: \$150***

**Course Summary** This course is designed for people wishing to refresh or to learn the fundamental mathematical concepts that are used to describe electromagnetic wave behavior. The modules address all of the basic math concepts covered in a traditional undergraduate electromagnetics course in an ECE curriculum. These concepts include Vector Basics, Integral Vector Calculus, Differential Vector Calculus, Fundamental Coordinate Systems and Complex Numbers. After completing these modules, a person should have sufficient math skills to pursue graduate studies in electromagnetics and/or be able to decipher the math presented in an upper-level text on the subject.

**Target audience:** This course is designed for people wishing to refresh or to learn the fundamental mathematical concepts that are used to describe electromagnetic wave behavior.

### **Course chapters**

1. Vector Basics
2. Dot Product

3. Cross Product
4. Contour Integration
5. Vector Algebra
6. Surface Integration
7. Metric Coefficients
8. Coordinate Systems
9. Vector Coordinate Conversion
10. Del Operator and the Gradient
11. The Curl
12. Divergence
13. Stokes Theorem
14. Divergence Theorem
15. Laplacian
16. Complex Numbers

### **Instructor's Bio:**

Dr. Kent Chamberlin is the Chair and a Professor in the Department of Electrical and Computer Engineering. In his more than thirty-five years in academia, he has performed research for more than twenty sponsors, including the National Science Foundation. He has received two Fulbright awards, including the prestigious Fulbright Distinguished Chair, which he served in Aveiro, Portugal. He has also served as an Associate Editor for the Institute for Electrical and Electronics Engineers, and he continues to be active in performing and publishing in a range of research areas.

<http://ieeeboston.org/fundamental-mathematics-concepts-relating-electromagnetics-line-course/>

# Reliability Engineering for the Business World *(Online Edition)*

***Students have access to this self-paced course for 90 days!!***

***Registration Fee: \$320***

## Course Description

This course is about becoming a leader in reliability engineering. While statistics are the tools of reliability engineering, it takes knowledge not only of these tools but also of the business. Developing knowledge of the business, from sales, engineering, customer service, to supply chain management can determine how effective you can be in improving reliability.

Never take anything for granted, even some rules of thumb in reliability can be misleading, this course will show you how to prove what truly happens in the real world and how to effect change in any part of the business where it is needed. We will explore the balance sheet, organizational structure, customers, service, and high volume manufacturing. It's not just about how often things fail, it is also about where the defect came from, what is the financial effect, the recovery, when should a business take field action, effect of human error, failure analysis/material science, reliability testing, and much more. I will also discuss how you develop executive buy in for change. The course assumes a basic knowledge in reliability statistics. There are 12 sessions that cover the following topics.

## Course Outline

Basics – Measurements  
Business Model  
Design Model (HW and SW)

HALT/RDT/Predictions  
Manufacturing Model  
Early Life Failures  
Wear Out and Mid Life Crisis  
Advanced Reliability

## Course Objective

To teach you how to become the go to person in your business for objective business sensed reliability answers and requirements.

## Instructor's Bio

Kevin is an innovative leader in reliability methodologies with more than 30 years experience in the storage industry. In his latest role as Director of Engineering, he developed a top down reliability/availability management process for design organizations developing mission-critical storage systems. Kevin previously directed the most extensive HALT/HASS operation in the industry, with over 300 chambers worldwide. He has written several papers, consulted with many companies, 3 patents awarded and 2 pending related to systems reliability and test.

His most recent work has been performing system architectural analysis to optimize system availability, serviceability and costs. Providing guidance to development to maximize system reliability and reduce service costs. He has provided consultation to many large companies such as EMC, CISCO, AT+T, HP, Seagate and many others. His position and experience has enabled him to perform extensive field studies and design of experiments. Kevin has developed many

**<http://ieeeboston.org/reliability-engineering-business-world-line-course/>**

# Introduction to Embedded Linux

## (Online Edition)

**Students have access to this self-paced course for 90 days!!**      **Registration Fee: \$350**

### Course Summary:

This first of a 2-part series introduces the Linux Operating System and the use of Embedded Linux Distributions. The course focuses on the development and creation of applications in an Embedded Linux context using the Eclipse IDE. The first part of the course focuses on acquiring an understanding of the basic Linux Operating System, highlighting areas of concern for Embedded Linux applications development using Eclipse. The latter part covers the methods for booting Embedded Linux distributions including embedded cross-development and target board considerations.

### Who Should Attend:

The course is designed for real-time engineers who are building Embedded Linux solutions. It is also targeted at experienced developers requiring a refresher course on Embedded Linux. This course will clearly demonstrate both the strengths and weaknesses of the Linux Operating System in Embedded Systems.

### Course Objectives:

To provide a basic understanding of the Linux OS and the Eclipse IDE framework.

To gain an understanding of the complexities of Embedded Linux Distributions and their use in embedded systems.

To give students confidence to apply these concepts to their next Embedded Linux project

Hardware and Software Requirements

The student should have a working Linux desktop environment either directly installed or in a virtualization environment. The desktop Linux should have the GNU compiler and binary utilities (binutils) already installed. A working Eclipse C/C++ installation or prior knowledge of C-based Makefiles is

useful for completion of lab exercises. Lab solutions are also provided with the course. An Embedded Linux target hardware platform is useful but not absolutely required for this course.

### Additional Reference Materials

Linux Kernel Development by Robert Love

Linux System Programming by Robert Love

Linux Debugging and Performance Tuning by Steve Best

Optimizing Linux Performance by Phillip G. Ezolt

Embedded Linux Primer by Christopher Hallinan

Pro Linux Embedded Systems by Gene Sally

Embedded Linux Development Using Eclipse by Doug Abbott

Linux Device Drivers by Jonathan Corbet et al

Essential Linux Device Drivers by Sreekrishnan Venkateswaran

Course Downloadable Content:

Video Lecture

Hands-On Lab Instructions

Hands-On Lab Solutions

Additional Related Materials

### The Basics

Linux Terminology, History and Versioning

The Linux Community: Desktop & Embedded

The GPL

Linux References (Books and Online)

### Getting Started

Kernel Source Code

Building the Kernel

Embedded Linux Kernels

Linux 2.6

### Basic Kernel Capabilities

Process and Threads Management

Signals and System Calls

Synchronization, IPC and Error Handling

Timing and Timers

Memory Management and Paging  
The I/O Subsystem: A Tale of Two Models  
Modularization

## **Debugging**

Process-Level and System-Level Debug  
GDB and KGDB  
GDB Server and Remote Debugging

## **An Eclipse Debug Example**

## **Other Debug and Test Tools**

## **Other System-Level Debug Approaches**

## **Process & Threads Management**

What are Processes and Threads?  
Virtual Memory Mapping  
Creating and Managing Processes and Threads  
Thread-Specific Data (TSD) POSIX  
The Native POSIX Threading Library (NPTL)  
Kernel Threads

## **Signals**

## **System Calls**

## **Scheduling**

Linux 2.4 and 2.6 Scheduling Models  
The O(1) Scheduler  
The Completely Fair Scheduler (CFS)

## **Synchronization**

Via Global Data  
Via Semaphores, Files and Signals

## **Inter-Process Communications (IPC)**

Message Queues  
Semaphores Revisited  
Shared Memory  
Pipes, FIFOs and Futexes  
Remote Procedure Calls  
Networking

## **Error Handling**

errno and perror  
strerror and strerror\_r  
oops, panics and Segmentation Faults

## **Timing**

How Linux Tells Time

Kernel, POSIX and Interval Timers  
High-Resolution Timers (HRTs)

## **Memory Management and Paging**

Demand Paging and Virtual Memory  
Allocating User and Kernel Memory  
Mapping Device Memory  
The Slab Allocator  
The OOM Killer  
Memory in Embedded Systems

## **Modularization**

Creating a Module and Module Loading  
Dependency Issues  
In Embedded Systems

## **Shared Libraries**

A Shared Library Example  
Static and Dynamic Libraries

## **The I/O Subsystem: A Tale of Two Models**

The Original Device Driver Model  
The Standard I/O Interface  
The New Device Driver Model and Kernel Object Classes  
Initialization  
Platform Devices, Busses, Adapters and Drivers  
Comparing the Two Models

## **Embedded Linux Trends**

Development, Monitoring and Testing

## **Some Final Recommendations**

## **Lecturer:**

Mike McCullough is President and CEO of RTETC, LLC. Mike has a BS in Computer Engineering and an MS in Systems Engineering from Boston University. A 20-year electronics veteran, he has held various positions at Titera, Embedded Planet, Wind River Systems, Lockheed Sanders, Stratus Computer and Apollo Computer. RTETC, LLC is a provider of Eclipse-based development tools, training and consulting for the embedded systems market.

# Design Thinking for Today's Technical Work

## (Online Edition)

***Students have access to this self-paced course for 90 days!!***

**Registration Fee: \$160**

### Course Description:

This course covers the principles of Design Thinking; the steps commonly used; how it enhances the likelihood of success in a wide variety of applications; and, in particular, how to apply it to technical work. Examples of its application to technical work are presented along with the successes that followed.

Design Thinking has garnered much attention in recent years mainly as a way to design consumer products that engage users, such as Apple's iPhone. But its use is spreading to situations ranging from how to provide medical care to planning one's career. This course explains what Design Thinking is about, but, most important, explains how an individual can apply Design Thinking to their own technical work. Care has been taken to focus the course content on using Design Thinking as a structured, practical process for the daily work of technical professionals. A specific technical example is carried through the teaching of the five stages of Design Thinking. The course covers applying Design Thinking to the range of tasks performed during a technical project, including design of: technical functions; user interactions (if applicable); factors for business success; solutions to problems that arise; and project presentations and reports to influence adoption of project outcomes, funding approval, and hiring for consulting. The content applies to employees of large to small companies, start-ups, consultants and contract work, and government organizations. The course is focused on an individual worker employing Design Thinking.

### Course Objectives

Provide an understanding of Design Thinking and how an individual can apply it to their technical work:

- Understand the steps of Design Thinking (Understand, Define, Ideate, Prototype, and Test)
- Learn how to apply Design Thinking in technical work
- Understand where Design Thinking can be applied in project activities.

### Who Would Benefit from this Course

Anyone who works on solutions to problems or designs hardware, software, products, services, and processes. This includes technical professionals, project managers, and organizational managers. Also, anyone who wants to learn what Design Thinking is about in a practical sense.

### Course Modules

- Module 1 – How Design Thinking Can Help Technical Work (60 minutes)
- Module 2 – Understand: Explore the Problem (44 minutes)
- Module 3 – Define: Synthesize What Is Needed (23 minutes)
- Module 4 – Ideate: Generate Solutions (26 minutes)
- Module 5 – Prototype: Build Versions to Test (23 minutes)
- Module 6 – Test: Examine and Learn (28 minutes)
- Module 7 – Design Thinking for Presenting and Writing (23 minutes)

- Module 8 – Getting Started with Design Thinking (30 minutes)

### Speaker biography

Speaker: James L. Poage, President/Owner JLP Performance Consulting

Dr. James L. Poage has been designing future concepts for Air Traffic Control for 25 years, first with the Volpe National Transportation Systems Center and then for the past dozen years as an independent consultant (JLP Performance Consulting). He has taught short courses on Benefit-Cost analysis to the FAA and NASA, as well as spoken at conferences and published in professional journals. Over the past 15 years, Dr. Poage has been applying Design Thinking to his project work; to marketing

his consulting services; and to planning briefings, reports, and courses. His clients have included FAA, NASA, BAE Systems, Engility, Georgia Tech University, San Jose State University, and Saab Sensis. Dr. Poage has co-authored the book, *Flair: Design Your Daily Work, Products, and Services to Energize Customers, Colleagues, and Audiences* (Maven House Press, 2016), with his daughter, Jennifer Poage who works in fashion design. Dr. Poage has a Ph.D. in applied mathematics from the Harvard University School of Engineering and Applied Sciences and a M.S. and B.S. in electrical engineering from Stanford University.

**Note: Course participants will receive a copy of the book, *Flair*.**

## 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 diverse 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](http://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](mailto: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.