

# BOSTON



# THE REFLECTOR

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## IEEE Boston Section Online Courses:

**Verilog101:Verilog Foundations** CLASS DESCRIPTION: Verilog is IEEE standard 1364. It is a Hardware Description Language that is the corner stone of much of the simulation world. Verilog Foundations is a comprehensive introduction to the IEEE 1364 (Verilog). The Verilog Foundations class has a slightly different approach to learning Verilog than other methods. There is a lecture section for each main topic. This presents a basic foundation for the language. What makes Verilog Foundations exciting is the emphasis on labs/examples. There are nearly 100 labs/examples giving comprehensive “how to” examples of most Verilog language constructs. There are working solutions for each lab and the students can use the lab database for developing their own models later. The class is also self paced. All the work can be done independently by the engineers, at their own computer, and at their own pace.

**(Register at <http://www.ieeeboston.org>) and click on course title**

**System Verilog 101: Design Constructs** CLASS DESCRIPTION: SytemVerilog is an extensive set of language constructs to the IEEE 1364-2001 standard. It's meant to aid in the creation and verification of models. There are two parts to the language extension. The first part covered by this class, is new design constructs. The second part of SystemVerilog is verification constructs, covered by SystemVerilog102. There are over 100 labs/examples giving comprehensive “how to” examples of most SystemVerilog language constructs. There are working solutions for each lab and the students can use the lab database for developing their own models later. The class is also self paced. All the work can be done independently by the engineers, at their own computer, and at their own pace. There are self-grading quizzes for each chapter that allow the student to see if he/she is learning the material. The goals of this course are to make you familiar with the new part of the language. Students taking SystemVerilog101 will have a 90-day access to it. The lab database you will be able to download and is yours to keep. **(Register at <http://www.ieeeboston.org>) and click on course title**

**System Verilog 102: Verification Constructs** CLASS DESCRIPTION: SytemVerilog is an extensive set of language constructs to the IEEE 1364-2001 standard. It's meant to aid in the creation and verification of models. There are two parts to the language extension. The first part covered by SV101, is new design constructs. SV102, this class, covers verification constructs. SystemVerilog102, like all CBE classes, is lab based. There are over 30 verification labs/examples giving comprehensive “how to” examples of most SystemVerilog verification language constructs. There are working solutions for each lab and the students can use the lab database for developing their own assertions later. The class is also self paced. All the work can be done independently by the engineers, at their own computer, and at their own pace. **(Register at <http://www.ieeeboston.org>) and click on course title**

**Introduction to Embedded Linux Part I** CLASS DESCRIPTION: 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.

**High Performance Project Managment** CLASS DESCRIPTION: This 12 hour course (broken into short 10 to 20 minute independent modules) provides the project methodology, concepts, and techniques that ensure successful completion (on time, on budget, with the quality required) of projects, large and small. Participants learn the steps to take before, during, and at the end of a project to hone planning and execution to a strategically built process that delivers project success when used. Additionally, the course provides the interpersonal and leadership techniques to ensure everyone involved with the project whether a team member, organization member, or outside of the organization commits to the success of the project—voluntarily—and provides the support and assistance to ensure its success. In addition to learning how to master the technical skills that have evolved over thousands of years of project implementation and practice, the course provides the advanced team building, leadership, and interpersonal skills that ensure the technical skills can be used, they way they are designed to be used, resulting in a process that delivers the on time, on or under budget, with the quality required completed project consistently.

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## Meanderings

Fausto Molinet, Jr. Past Chair, Boston Section

Well, it has been almost one year since I relinquished my post as Section Chair to my successor, Kevin Flavin. Now I have had a little time to recover and reflect on the years I spent in leadership roles, which incidentally are not totally done since I was drafted to be chair of the publications committee, but that just gives me a formal role in which to reflect on the past and leave words of wisdom to others (in texting/Facebook parlance LOL).

Seriously, sort of, there are three topics I feel that more of our section members and engineers in general in the Boston area ought to consider. They are: participation in the profession, continuing education, and volunteerism. This isn't a comprehensive list of topics, but three is enough to think about at once.

Let's start with participation in the profession. You may wonder, "Why this? I'm an engineer and I do that all day. I must be participating." Well, yes, but only partly. In our day to day job, which in today's technology sector, may extend long into the evening and weekend, we may do engineering, but what are we doing to advance the profession. It's not just the technology, it's the entire body of knowledge and practice, and ethics and relationships and the sharing and the new ways of thinking and considering what the future will be like for the next generation of engineers and those who benefit from our talents. But, "Gee whiz, that's a lot of stuff I don't know anything about and couldn't change

anyway." Right, not alone, but with others we might make a dent. That's what IEEE, "Advancing Technology for Humanity", is all about. Its 400,000 engineers, banded together, loosely of course, where each of us can have some small role in a part of that profession and collectively improving it, for humanity. The bottom line here is if you are a member of IEEE, be sure to renew your membership and participate in activities. If you are not, seriously consider joining. It can't hurt and there are certainly benefits available, no matter how much or little you participate.

Now, if you've been paying attention to the technology sector you are certainly aware how much and how rapidly things are changing. I started in what is surely the dark ages, where my professors were much more interested in big motors and vacuum tubes and those pesky solid state devices would never really work. Computers occupied whole buildings and we certainly did not want more than 3 or 4 of them. My, my, how things changed, and the survivors in our profession changed with them. There was a common thread which linked them - continuing education. Of course we were all smart and could with time figure out how most of the new-fangled gadgets worked, but frankly we just didn't have the time to do that. We had to, and still have to, rely on a few people to work out the details and develop presentations and courses on this new stuff and make the learning process relatively fast. Today as things change even faster, us-

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ing more and more complex processes, the need for this education is even more critical. What you are doing today could be superseded by something radically new that you know next to nothing about. We all need to learn and be prepared to radically shift direction and get some experience, before it's absolutely necessary. The Boston Section of IEEE offers courses that are inexpensive and taught by real experts that give tools to use on the job, now. Consider taking a course and if you are one of those experts with something to say, consider suggesting, developing and teaching one. PS, it helps advance the profession, remember?

Tying these things together is volunteerism. To get anything done, somebody has to do it. Of course there is probably a "committee for that". Now nothing ever really gets done by a committee, it's the individual volunteers who make up that committee. The volunteers are a vital part of any activity and we always need more of you. There are a lot of rewards, just not in cash, although it can lead to that. As an example, my IEEE activities led to some of my most valuable clients during a 25 year third-career in consulting. Also, to a lot of close friendships, some travel, that I might not otherwise have done and personal growth in confidence and competence. There are many levels of volunteerism and you can devote as much or as little time as you want, but every little bit helps. There are chapters

of societies in your technical specialty, conferences on topics in your area, section jobs, such as social media promotions and some of those committees on just about anything you can imagine. Give us a hand.

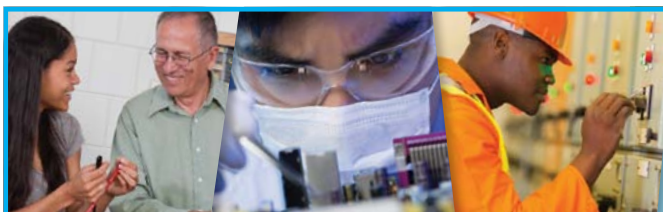
"Okay, I'm convinced, where do I start?" Take a look at [www.ieeeboston.org](http://www.ieeeboston.org). That's where you can find out what's going on locally and find out how to contact someone who can help you. Bob Alongi and Karen Safina who manage our Section office know everybody and how to reach them. They can point you to advisors or let you know about some specific volunteer needs we've already identified. If you are interested in sharing knowledge through a course, they'll tell you how to do that. If you want to begin by joining IEEE they can guide you through the process. Call them at 781-245-5405 and get started.

Fausto Molinet is a former USAF acquisitions officer and had 10 years post retirement employment in the defense industry with Litton Itek Optical Systems. He is one of the founders of the Entrepreneurs' Network (ENet) and consulted to small and large technology companies in strategy for 25 years. He is currently Chief Business Development Officer for Celeriss, Inc., a member of the ENet Advisory Board and Chair of the Boston Section Publications Committee.

*As always, the views expressed in our editorials are those of the author and not necessarily those of the IEEE Boston*

Letters to the editor can be sent to,  
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*Entrepreneurs' Network - 6:30PM, Tuesday, 6 September*

# What Builds The Most Value in A Tech or MedTech Startup

Meeting Location – Constant Contact, 3rd Floor Great Room, 1601 Trapelo Road, Waltham, MA .  
PRE-MEETING DINNER at 5:15 PM (sharp) at Bertucci's, Waltham.

On September 6, 2016, ENET will kick off its 26th year with a meeting devoted to setting goals for founders and entrepreneurs. Our subject - What builds the most value in a tech or medtech startup Company? A starting point will be defining the value proposition of your company's product or service. Do you fix a problem that has real and measurable consequences to inaction? Is this problem a top priority to your target customer? Is the market significant? Is it under served?

To build value in your company, you will be judged first on that value proposition, but then beyond that on the management team you assemble, your technology, your customers, your business model and scaling potential and the market you serve. Under the lean startup model, you build a small amount, then measure and learn. Constant iterating based on actual results from customers. In tech companies and specially in med tech and life science companies, the management team is critical to move the company through the inevitable issues you face, to be able to quickly pivot to redirect engineering efforts to keep the company on track to meet its milestones to commercialization. A key part of management's ability to execute, will be to manage cash to reach inflection point where clinical or customer impact, IP and franchise value has been established to achieve a favorable exit.

Those are just some of the issues; ENET will parse on September 6, with our three expert speakers. Our speakers that night include the CEO of a Boston M&A firm, twice nominated for "Woman Deal

Maker of the Year" for her work building value in companies to successful exits, a life sciences investor and director of an organization that brings together executives across med tech and life science fields, and the President of one of the most successful VC/angel firms that invests exclusively in Massachusetts startup companies. The panel will be moderated by ENET's chairman who has been recognized as one of the "Top 20 Boston Startup Attorneys".



Speaker: Walter M. (Jerry) Bird, President, MassVentures,  
<http://www.mass-ventures.com/>

MassVentures is a venture capital firm that provides capital for technology startups not adequately served by the venture community, including companies from all across Massachusetts, as well as first-time CEOs or founders, Jerry has over 25 years of experience advising and financing entrepreneurial-driven companies, the past 18 in venture capital. Throughout his professional career, Jerry has operated both as an investor and an active partner to entrepreneurs building their companies. His direct investment experience covers dozens of companies and in many cases as the lead or co-lead investor. Several of these companies were acquired by significant publicly-traded companies. Among the companies Jerry has been on the board of are e-Travel (acquired by Oracle), Andover.net (Nasdaq: ANDV, purchased by VA Linux), LinkSoft Technologies (purchased by QuadraMed), NexCen Technologies (purchased by UCMS), and Bitpipe Inc. (purchased by TechTarget). He currently is a board member or board observer at MassVen-

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tures' portfolio companies Forerun, lifelIMAGE, and Applause (formerly uTest).. He's on the boards of Massachusetts Audubon, Crossroads for Kids, and the Massachusetts chapter of the Trust for Public Land. In his free time, Jerry spends time in the mountains on his bike or skiing or hiking.



Speaker: Jordan Leef, Healthcare VC and Director, The BioBreak Organization  
<http://www.biobreak.org/>

Mr. Leef is a healthcare venture capitalist and member of the Board of Directors of the BioBreak Organization, an executive networking organization for the life sciences

industry, bringing together senior executives from across the biotech, pharma, medtech, diagnostics and venture capital industries. He was previously a Financial Analyst for Pharos Capital Group, a private equity firm located in Nashville and Dallas. In this capacity, Mr. Leef worked as a member of the Pharos investment team to provide growth and later-stage capital for businesses in underserved areas of the nation focusing on firms in the healthcare, business services and technology industries. Prior to Pharos, Mr. Leef worked in the Biotechnology Equity Research Group at C.E. Unterberg, Towbin in New York City, where he was responsible for writing research reports, providing sector analysis and valuing drug companies and their pipelines. He also previously worked at Pfizer, Inc. in the U.S. Clinical Operations Division, where he worked with CROs to manage clinical trials and helped coordinate regulatory release of several new compounds. Mr. Leef holds a B.S. degree from University of Pennsylvania.

Speaker: Marguerite A. Piret, President & CEO, Newbury Piret & Company, Inc.,  
<http://www.newburypiret.com/>

Ms. Piret is the president and CEO of Newbury



Piret & Company, Inc., a leading Boston-based middle market investment bank. She has effected numerous financing and sale transactions for public and private companies in industries including manufacturing, technology, healthcare, and financial and business ser-

vices both in the US and internationally. Previously, she was Managing Director of Kridel Securities Corporation, an investment bank with offices in New York, London and Paris. On behalf of European and American clients, she provided corporate finance services to the medical, biotechnological, environmental, energy and industrial products industries. Prior to Kridel Securities, Ms. Piret was a Commercial Loan Officer at the New England Merchants National Bank (now the Bank of America). In 2004, Newbury Piret & Co. won the M&A Advisor's national award for best Industrial Manufacturing Deal of the Year in the Middle Market. Ms. Piret was also nominated for Woman Dealmaker of the Year in 2004 and 2005. Ms. Piret is an Independent Trustee and Chairman of the Valuation Committee of the Pioneer Mutual Funds. She serves as Trustee of the Massachusetts Eye and Ear Infirmary and Foundation. She holds A.B. and MBA degrees from Harvard University.



Moderator: Robert Adelson, business and tax attorney, partner at Boston law firm of Engel & Schultz LLP ([www.ExecutiveEmploymentAttorney.com](http://www.ExecutiveEmploymentAttorney.com)), and Chairman of The Boston Entrepreneurs' Network.

Rob has been an attorney for over 30 years specialized in business, tax, stock and options, employment, contracts, financings, trademarks and intellectual property. Rob began as an associate at major New

York City law firms before returning home to Boston in 1985 where he has since been a partner in small and medium sized firms before joining his present firm in 2004. Rob represents entrepreneurs, start-ups and small companies, independent contractors and employees and executives, and family businesses. Rob is a frequent speaker on business law topics and author of numerous articles published in Boston Business Journal, Mass High Tech and other publications. He has been named among the "Top 20 Boston Startup Lawyers" by ChubbyBrain.com, a website that provides tools for entrepreneurs. Rob has been on the ENET Board since 2002 and Chairman since 2009 and is also a Co-Founder and Board member of the 128 Innovation Capital Group. In January 2016, he received the professional achievement award from IEEE-USA for "extreme dedication and contributions to the IEEE entrepreneurship community." He holds degrees from Boston University, B.A., summa cum laude, Northwestern University (Chicago), J.D., Law Review, and New York University, LL.M. in Taxation.

Meeting Location: Constant Contact, Inc., Reservoir Place, 3rd Floor Great Room, 1601 Trapelo Rd., Waltham, MA (Exit 28B, I-95/Route 128)

Pre-meeting Dinner at 5:15 PM (sharp) at Bertucci's, Waltham, (Exit 27B, Route 128)

Check for Updates at: Boston Entrepreneurs' Network Website at ( <http://www.boston-enet.org> )

Directions: <http://www.constantcontact.com/about-constant-contact/office-location-waltham.jsp>

Reservations: ENET Constant Contact meetings are free to ENET members and \$20 for non-members. No reservations are needed for the dinner. 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.

*Communications Society – 7:00PM, Thursday, 8 September*

## Rapid Band 14 LTE for Major Events

Steve Kropper, Parallel Wireless



Because of vendor and facility constraints, telecom carriers need months to plan and deploy LTE (Long Term Evolution) wireless networks for scheduled events. RF and network planning needs design experts. Equipment needs to be selected, installed and tested.

Suppose an urgent need required LTE deployment

for a major event as fast as public safety agencies can dispatch fire, police and medical teams? What would that network look like? Join us to hear of a system deployed in 21 days for Super Bowl 50 and another in 18 days for the 2016 Republican National Convention in Cleveland. What happens when all four redundant layers of backhaul and broadcast evaporate three days before the RNC. Learn what technology and management allowed the event to proceed (mostly) smoothly.

Parallel Wireless' customers include British Telecom, Telefonica, the RNC, Lollapalooza, FirstNet, the Indianapolis Motor Speedway and M1 Singa-

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pore. They have provided demonstrations to the Department of Defense, Homeland Security, APCO 2015 and the 2016 International Wireless Communications Expo.

**The Speaker:** Steve Kropper began his telecom career with Cable & Wireless, Martin Marietta, Bell Canada, Clear (New Zealand) and as a telecom analyst at IDC. As the Internet evolved, Steve founded the largest consumer property web site in the field – Domania.com (sold to Lending Tree). He founded WindPole Ventures, leveraging a portfolio of 12,000 tall towers to provide real-time data for five of the top ten developers like BP and Duke Power. Steve developed corporate strategy in regulated and unregulated markets in energy, telecom and financial information fields. Today he is VP at Parallel Wireless in Nashua, NH, leading its business development in the public safety sector. Steve holds a BA from BU and MBA from Cornell.

The meeting begins at 7 PM at the Verizon Technology Center, 60 Sylvan Road, Waltham, MA 02451.

The entrance is by the far southwest corner – with the picnic tables. It is most easily reached by the West Street entrance.

**Important Note:** Everyone is invited to attend, however Verizon Technology Center requests the names of the meeting attendees in advance of the meeting. Please send a note via e-mail with your name to John Nitzke at RF@ieee.org by COB Wednesday, September 7th.

**The meeting is preceded by dinner at Bertucci's Italian Restaurant, 475 Winter St, Waltham at 5:30 PM. The speaker will be joining us at dinner. Please let Bob Malupin know in advance if you plan to attend the dinner. Bob can be contacted at Robert.Malupin@VerizonWireless.com.**

**Please circulate this notice to interested parties. To assist us in planning this meeting, please pre-register at <http://www.ieeeboston.org/Register/>.**

*Photonics Society – 6:30PM, Thursday, 8 September*

## Space-Division Multiplexed Optical Communications Over Multi-mode Fiber

Nicolas Fontaine - Nokia Bell Labs, New Jersey



Space-division multiplexed (SDM) systems use the multiple spatial modes in either multi-core fiber (separated modes), or the spatially overlapping but orthogonal modes in multi-mode fibers to either increase the capacity or photon-efficiency of optical fiber links. The new challenges in

SDM are how to couple into and out of the various SDM fibers without insertion loss (IL) or mode-de-

pendent loss (MDL), and building components that have comparable performance to, and that offer a cost advantage over systems using multiple single-mode fibers. We will show several components for space-division multiplexing in multi-mode fibers including “photonic lantern” spatial multiplexers which are lossless adiabatic single-mode to multi-mode converters, multimode amplifiers, and wavelength selective switches for routing signals in few-mode fiber. These components enable transmission of signals across multi-mode fiber using up to 30 spatial and polarization modes.

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Nicolas Fontaine obtained his Ph. D. in 2010 at the University of California, Davis in the Next Generation Network Systems Laboratory [<http://sierra.ece.ucdavis.edu>] in Electrical Engineering. In his dissertation he studied how to generate and measure the amplitude and phase of broadband optical waveforms in many narrowband spectral slices. Since June 2011, he has been a member of the technical staff at Bell Laboratories at Crawford Hill, NJ in the advanced photonics division. At Bell Labs, he develops devices for space-division multiplexing in multi-core and few mode fibers, builds wavelength crossconnects and filtering devices, and investigates spectral slice coherent receivers

for THz bandwidth waveform measurement. Directions to Forbes Rd Lincoln Laboratory: (from interstate I-95/Route 128)

- Take Exit 30B onto Marrett Rd in Lexington – Merge into left lane
- Make the first Left onto Forbes Rd.
- Proceed straight through the small rotary and enter the parking lot.
- The entrance is on your right.

**To assist us in planning this meeting, please pre-register at**  
<http://www.ieeeboston.org/Register/>.

## Locally held IEEE Conferences

**2016 IEEE High Performance Extreme Computing Conference**  
 September 13 - 15 2016  
 (Conference and hotel registration now open!!!)  
[www.ieee-hpec.org](http://www.ieee-hpec.org)

**2017 IEEE International Symposium on Technologies for Homeland Security**  
 April 25 - 26, 2017  
[www.ieee-hst.org](http://www.ieee-hst.org)  
*(Note new paper submission schedule: Submission deadline is October 17, 2016)*

**2016 IEEE International Symposium on Phased Array Systems & Technology**  
 October, 18 - 21 2016  
 (Conference and hotel registration now open!!!)  
[www.array2016.org](http://www.array2016.org)

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*Robotics and Automation, Consumer Electronics, Solid-State Circuits, and Computer Societies - 6:15PM, Tuesday, 13 September*

# Technologies, Tools, and Processes for Animatronic and Electronic Toy Development

Animatronic and Electronic toy and game development is an exercise in suspending disbelief with the lowest cost possible. This session will explore the in's and out's of animatronic and electronic toy and game design and value engineering; the overall development process; and how ever-changing consumer insights and expectations fuel the need to quickly develop new capabilities to stay on trend. Specifically, two of the foremost experts in this field will take us through identifying the consumer insights; defining key magic, marketable features of a product experience; the design mentality and process needed to realize those features; the electronic component selection process and IC toolchains required; and what's involved in prototyping, model development, gameplay development, design for manufacture, testing, and software quality control.

Jonathan A. Palé -- VP, Global Engineering and Technology; Jonathan came to Hasbro in 2005 after spending nearly a decade as an electrical engineer in the defense industry; designing printed circuit boards, FPGAs, and writing embedded software. Armed with his knowledge of advanced technologies from the defense world, Jonathan took to finding ways to apply these technologies cost-effectively in toys and games. Jonathan and his world-class team of engineers, designers, and project managers at Hasbro have been behind the development of many award-winning play experiences: FURBY BOOM; FURREAL FRIENDS STARLILY, MY MAGICAL UNICORN; SESAME STREET LOVE2LEARN ELMO; STAR WARS REMOTE CONTROL BB-8 DROID; SCRABBLE FLASH; and many more. Jonathan holds a BSEE from Rochester Institute of Technology (1997) and an MBA from Northeastern University (2009).

Don Cameron -- Manager, Animatronics; Don started at Hasbro in 2003 as an intern with a passion for bringing toys to life. Joining Hasbro fulltime in 2005, he contributed to the early development of the FURREAL FRIENDS line of animatronic products, including Toy of the Year winners BUTTER-SCOTCH and BISCUIT MY LOVIN' PUP. Under the mentorship of Richard Maddocks, Don has championed the integration of design and engineering in toy animatronics. Don was a key developer on FURBY in 2012 and has been instrumental in establishing Hasbro as a leader in app-integrated product design. In 2015 he took over as manager of the Animatronics Development team, leading a team of talented engineers to support Hasbro's animatronics needs across all of the company's brands. Don holds a BFA from the Rhode Island School of Design (2004).

Craig Desrosiers -- Director, Applied Technologies; Craig leads Hasbro's Applied Technologies group, looking for ways to bring in new technologies and make them real for Hasbro's brand teams. His team leads execution on many high complexity projects including FurReal Friends Starlilly My Magical Unicorn and Torch My Blazin Dragon, Playmation, NERF Terrascout RC Drone, and new brands like Hanazuki. They champion technologies like Bluetooth, NFC, and WiFi. Prior to Hasbro, Craig led a team developing electronic products for Graco Children's Products. He holds a BSEE from Northeastern and an MSEE from Drexel University with focus on Engineering Management, semiconductor physics, digital signal processing, and system architecture.

## COMPANY HISTORY

Hasbro (HAS) is a global company committed to

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#### **UNHOSTED DINNER**

**Olive Garden, 1240 Newport Ave., South Attleboro, MA 02703**

Have more questions? Want to share a drink with the speaker? Want to network with fellow engineers and professionals? Just want to chat about the current goings-on in Robotics, or technology in general? Join us for dinner, where you can talk about Robotics in a more casual setting!

**Doors open: 6:15 P.M., Presentation: 6:45 P.M., Dinner: 8:30 P.M.**

**Hasbro Inc. 1027 Newport Avenue, Pawtucket, RI 02861-2500**

**This and other RAS meetings are open to the general public. For more information about the RAS Boston Chapter, contact Chapter Chair Ryan Pettigrew at [chair@robotics-boston.org](mailto:chair@robotics-boston.org) or visit <http://www.robotics-boston.org/>.**

**To assist us in planning this meeting, please pre-register at <http://www.ieeeboston.org/Register/>.**

*Reliability Society – 5:30PM, Wednesday, 14 September*

## **Software Reliability: Tools and Algorithms**

Dr. Lance N. Fiondella



While there are many software reliability models, there are relatively few tools to automatically apply these models. Moreover, these tools are over two decades old and are difficult or impossible to configure on modern operating systems without a virtual machine. To overcome this technology gap, we are developing an open source software reliability tool for the software engineering community. A key challenge posed by such a

project is the stability of the underlying model fitting algorithms, which must ensure that the parameter estimates of a model are indeed those that best fit the data. If such model fitting is not achieved users who lack knowledge of the underlying mathematics may inadvertently use inaccurate predictions. This is potentially dangerous if the model underestimates important measures such as the number of faults remaining or overestimates mean time to failure (MTTF). To improve the robustness of the model fitting process, we are developing expectation maximization (EM) and expectation conditional maximization (ECM) algorithms to compute

technology gap, we are developing an open source software reliability tool for the software engineering community. A key challenge posed by such a

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the maximum likelihood estimates of nonhomogeneous Poisson process (NHPP) software reliability growth models (SRGM).

This talk will present an implicit ECM algorithm for the Weibull NHPP SRGM. The implicit approach eliminates computationally intensive integration from the update rules of the ECM, achieving a speedup of between 200 and 400 times that of explicit ECM methods. The enhanced performance and stability of these algorithms will ultimately benefit the software engineering communities that use the open source software reliability tool.

Lance Fiondella is an assistant professor in the Department of Electrical & Computer Engineering at the University of Massachusetts Dartmouth. He received his PhD (2012) in Computer Science & Engineering from the University of Connecticut. He conducts research in the areas of system and software reliability engineering and has published over 80 peer-reviewed journal articles and conference papers on these topics. He served as vice-chair of IEEE Standard 1633, IEEE Recommended Prac-

tice on Software Reliability from 2013-2015 and is an elected member of the Administrative Committee of the IEEE Reliability Society (2015-2017). His research is funded by the National Science Foundation (NSF), Department of Homeland Security (DHS), Army Research Laboratory (ARL), and Naval Air Systems Command (NAVAIR).

Meeting Location: MIT Lincoln Laboratory, 3 Forbes Road, Lexington, MA 02421

#### **Agenda:**

**5:30-6:00 Sign In, Networking, Light Dinner & Refreshments**

**6:00-6:10 Chapter Chair Greetings & Announcements**

**6:10-8:00 Dr. Lance N. Fiondella, University of Massachusetts, Dartmouth**

**8:00-8:15 Q&A session, meeting adjourns**

**Admission: No Admission Charge.**

**To assist us in planning this meeting, please pre-register at <http://www.ieeeboston.org/Register/>.**

*Entrepreneurs' Network - Cambridge Meeting - 6:00PM, Tuesday, 20 September*

## **Non-Dilutive Funding and Ways to Bootstrap Your Startup Company**

Meeting location – Microsoft Technology Center, One Cambridge Center (Kendall Square, next to Marriott Hotel), Cambridge, MA.

Are you a founder? Are you trying to start your own business but don't have a trust fund to get it off the ground? Are you looking for ways to raise capital without giving up a huge chunk of equity? Non-dilutive Funding and bootstrapping could be your solution. As a savvy entrepreneur you have many funding options to choose from. Very few startups actually require VC funding as an initial funding

source. If you want to learn about practical methods to finance your startup using creative techniques without giving up equity, this event is for you!

So if you'd like to avoid giving up equity before you have to, come and listen to successful speakers how they did it. This session will bring together experts who have built great companies, who have used non-dilutive funding or bootstrapping techniques to move ahead from bright idea through prototype or minimum viable product, beta, and beyond without giving up equity.

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Moderator: Stacey Arbetter, Co-founder & CEO of Mutt Maps, Inc., <http://muttmaps.com/>

Stacey is a Serial Entrepreneur of several successful startups including the leading supplier in North America of an industrial product for the transportation industry and, previously, the largest independent exporter of automobiles in the U.S. Excels at identifying market opportunities. She is motivated by new challenges where complex, innovative problem-solving skills and business strategy can bring direct and immediate value to an enterprise. Stacey's latest startup is Mutt Maps. Mutt Maps is a web app developing a community for pet owners that delivers community-reviewed, geolocated, pet-friendly places, services and products.



Co-Moderator: Dr. Karthik Ganesan, Program Director, Cognizant Technology Solutions, <http://www.cognizant.com/>

Dr. Karthik Ganesan is the American Program Director for Business Consulting and Enterprise IT at Cognizant Technology Solutions, a NASDAQ

listed, Fortune 500 US Corporation. He manages a multimillion dollar portfolio of services for corporate customers, leading globally distributed teams to provide domain knowledge and technical services. Dr. Ganesan's experience spans applying optimization and domain knowledge skills to manufacturing, supply chain, logistics and retail operations in large corporations. As a domain leader, he manages teams spread across the USA, Latin America, Europe and India for delivering business and IT projects. He focuses on solving logistics operations and supply chain management and manufacturing problems faced by his customers. He is responsible for leading the business center in implementing full-life cycle solutions to his customers

within competitive, time constrained contractual terms. His responsibility extends to internal and external team management, customer satisfaction and securing repeat business for his group. Prior to taking this industry position, he spent over a decade in graduate level teaching and research in both engineering and business schools.

Where: Microsoft Technology Center, One Cambridge Center, Cambridge, MA. 02142 Phone: (781) 487-6400. MTC is across from the Kendall Square Post Office. Exit Kendall Square T Station to Main Street. Once you exit the station, head down the Marriott side of Main Street going in the direction of Boston/the Longfellow Bridge. The Technology Center entrance is located across from the new park at the confluence of Main Street and Broadway. See also: [http://www.microsoft.com/en-us/mtc/locations/boston\\_directions.aspx](http://www.microsoft.com/en-us/mtc/locations/boston_directions.aspx)

**Admission: General admission is \$10. Free to ENET members. Free Pizza and soft drinks will be served. Advanced registration is requested but not necessary.**

**For more information and updates, visit [www.boston-enet.org](http://www.boston-enet.org)**



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*Microwave Theory and Techniques, and Geoscience and Remote Sensing Societies—  
6:00PM, Wednesday, 21 September*

## Video Rate Microwave Imaging for Concealed Threat Detection

Dr. William Moulder, MIT Lincoln Laboratory

Public spaces such as mass transit systems, stadiums, and airport ticketing lounges face tremendous security challenges due to high foot traffic and easy concealment of threat items. A practical system that can screen subjects very quickly (ideally at video rate) can serve as a useful tool in securing such environments. Realization of such a system presents two major technical challenges: 1) implementation of an electrically large antenna array for capture of a moving subject, and 2) fast image reconstruction on cost-effective computing hardware.

This talk will discuss development of a system that employs a hardware-efficient multistatic array to address the former challenge, and a novel fast image reconstruction technique to address the latter. Experimental results will be presented illustrating that the array design can be used to form high fidelity 3D images, and that the fast imaging technique can construct a human-sized imaging domain in

<0.1sec on cost-effective computing hardware.

Dr. William Moulder is a technical staff member in the RF Technology group at MIT Lincoln Laboratory. His research interests include microwave imaging systems, wideband antenna arrays, and Simultaneous Transmit and Receive (STAR) technology. He received B.Sc. and Ph.D. degrees in Electrical and Computer Engineering from the Ohio State University.

**Refreshments and social time begins at 5:30PM, with chapter business and talk starting at 6PM.**

**Meeting Location: MIT Lincoln Laboratory, 3 Forbes Road Facility, Lexington, MA.**

**To assist us in planning this meeting, please pre-register at:**  
<http://www.ieeeboston.org/Register/>.

*Computer Society and GBC/ACM - 7:00PM, Thursday, 22 September*

## BigDAWG Polystore: Programmer Productivity for Complex, Heterogeneous Big Data Applications

Tim Mattson, Intel



If every algorithm looked like “map reduce” and all data naturally fit a single data store, solving Big Data problems would be straightforward. The real world, however, is not so simple. Most big data problems require complex analytics over data that is

spread out among multiple data stores. Current technology could be force-fit to address these problems, but only by sacrificing programmer productivity.

Research at the Intel Big Data Science and Technology Center (based at MIT with support from 4 other universities) is addressing this problem. Our

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central idea is a concept we call “polystore”. In a polystore system, multiple database systems with potentially different data models are exposed to the programmer through a single framework. Middleware supports location transparency and semantic completeness through a uniform interface. Our reference implementation for this concept is the BigDAWG stack (Big Data Analytics working group). In this talk, we will discuss the motivations and vision for BigDAWG, the current state of its architecture, the progress we have made in implementing it, and highlight the major challenges that lie ahead of us. An overview of some of the work is contained in <http://livinglab.mit.edu/wp-content/uploads/2016/01/big-dawg-polystore-system.pdf>.

Tim Mattson is a parallel programmer (Ph.D. Chemistry, UCSC, 1985). Tim has been with Intel since 1993 where he has worked with brilliant people on great projects such as: (1) the first TFLOP computer (ASCI Red), (2) the OpenMP API for shared memory programming, (3) the OpenCL programming language for heterogeneous platforms, (4) Intel’s first TFLOP chip (the 80 core research chip), and (5) Intel’s 48 core, SCC research processor.

Currently Tim is working in the Parallel Computing lab. He is (1) the PI for our Big Data science and technology center, and (2) leading a small group studying revolutionary approaches to runtime systems for exascale computers.

**This joint meeting of the Boston Chapter of the IEEE Computer 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.**

**To assist us in planning this meeting, please pre-register at: <http://www.ieeeboston.org/Register/>.**

*Geoscience and Remote Sensing, and Microwave Theory and Techniques Societies – 6:00PM, Wednesday, 28 September*

## **Update on Research and Development Activities at Atmospheric & Environmental Research**

Dr. Robert A. Morris, Vice President, R&D Division, and Chief Science Officer, Atmospheric & Environmental Research, Lexington, Massachusetts



Since its formation in 1977, Atmospheric & Environmental Research (AER) has conducted cutting-edge basic and applied research in the geosciences and environmental risk. While initially focused on atmospheric photochemistry, AER has expanded its footprint into a broad set of capabilities

in remote sensing, physical oceanography, meteorology, data assimilation, climate science, atmospheric composition and air quality, and space weather. In supporting its government customers, AER also provides on-site research and engineering staff at several US government research laboratories. We also transition environmental research results into commercial products. Recent and current R&D activities at AER will be presented, and the outlook for the future will be discussed.

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Dr. Robert Morris leads AER's Research & Development Division, which performs basic and applied research and technology development in the areas of atmospheric science, satellite data assimilation, physical oceanography, air quality, climate analysis, space environment, and space weather for government and commercial customers. Dr. Morris has over 24 years of government laboratory experience in space environment and remote sensing, including leading the Battlespace Environment Division of the Air Force Research Laboratory prior to its relocation to New Mexico in July 2011. He has published over 100 research articles in peer-reviewed scientific journals and over 100 conference papers; much of his research focused on the kinetics and dynamics of ion-molecule reactions. Dr. Morris is a Fellow of the American Physical Society and an AFRL Fellow. He earned his B.S. in chemistry at Bates College, his Ph.D. in physical chemistry at Boston College, and then served as a Geophysics Scholar postdoctoral fellow at the Air Force Geophysics Laboratory.

**Meeting Location: AER - Atmospheric and Environmental Research (AER) Inc., 131 Hartwell Avenue, Lexington, MA 02421.**

To assist us in planning this meeting, please pre-register at <http://www.ieeeboston.org/Register/>.



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IEEE

*Consultants Network - 6:30 PM, Tuesday, 27 September*

## How to Minimize EMI

Lee Hill, Silent Solutions, LLC

Electrical noise and EMI are the bane of every electronic circuit, and there is no easy way to minimize them.

In this talk, we will review:

- Why Electrical Noise Problems Arise
- How to Analyze Them
- How to Solve and Avoid Them
- Systematically analyze and solve noise problems by using the noise model to create and analyze a noise circuit schematic
- Minimize radiated EMI by designing low inductance signal interconnects
- Understand ground loops, how to represent them in an equivalent circuit, and how to eliminate them
- Clearly identify and manage the three different types of "ground" in schematics and physical circuits
- Identify "accidental antennas" in new designs
- Understand and measure common-mode current in emissions and immunity problems
- Improve the quality of sensor and instrumentation signals in the presence of noise

Lee Hill is Founding Partner of SILENT Solutions LLC, an independent electromagnetic compatibility (EMC) and RF design firm established in 1992. Besides providing EMC design review and troubleshooting services, Lee is a member of adjunct faculty at Worcester Polytechnic Institute (WPI), an EMC class instructor at the University of Oxford (England), and an EMC instructor for the IEEE EMC Society's annual Global University program and EMC Fundamentals workshop.

PLEASE NOTE: The meeting is open to the public. No charge for Consultants Network members or employees of Constant Contact; \$5 entrance fee for all others. Casual dress.

**Registration:** To assist us in planning this meeting, please pre-register at <http://www.ieeeboston.org/Register/>.

**The Consultants Network meeting starts at 6:30 PM. The meeting will take place at Constant Contact, Reservoir Place - 1601 Trapelo Road, Waltham, MA 02451, in the Great Room on the First Floor. A no-host, PRE-MEETING DINNER will take place at 5:15 PM (sharp) at Bertucci's, 475 Winter Street, Waltham, MA 02451 (exit 27B, Rte 128).**

**Driving Directions:** Follow I-95/route 128 to Trapelo Rd in North Waltham, Waltham. Take exit 28 from I-95/route 128. (<https://goo.gl/maps/tvn3l>)

**Consultants Network meetings generally take place on the fourth Tuesday of each month, but are not held during the summer months. Check the Consultants Network website for meeting details and last-minute information.**  
<http://www.boston-consult.com/calendar.php>

**For more information,**  
e-mail [cn.boston@ieee.org](mailto:cn.boston@ieee.org) or [chairman@boston-consult.com](mailto:chairman@boston-consult.com); or contact the chairman Heinz Bachmann, at 978-637-2070. The Consultants Network website is at [www.boston-consult.org](http://www.boston-consult.org).

# Hey!!! There's a Constitutional Amendment on Your Next IEEE Elec-tion Ballot

What!!? There's an IEEE Constitution? Someone wants to change it? Do I care?

Maybe these thoughts went through your mind when you read the title. Legitimate questions all. For most of us the IEEE Constitution doesn't really seem to be of much significance, being mainly for activists, people seeking office and staff. The IEEE runs itself pretty well and is in the more than adequate hands of the volunteer leaders, staff and paid executives. It's not of much interest technically.

I certainly agree, but there is a catch. It only works well because we, the members have a lot to say about how this pretty big (should I say huge?) organization runs. I am sure we would like to continue that and keep it working for us.

Hence, like anywhere else that there is a constitution, change can be hazardous and needs careful thought and consideration. Even the placement of a comma can fundamentally change the meaning of a provision.

It's incumbent on all of us to consider how this upcoming amendment will affect the future of IEEE and not just accept what the corporate staff thinks, or what a friend thinks, for example. We should make up our own mind and vote intelligently and thoughtfully.

The link below takes you to the official IEEE page which has a lot of information, including some statements in opposition to the amendment. You can also search for IEEE Constitutional Amendment on the search engine of your choice.

There is a lot of information here and it's admittedly a little hard to understand the significance of it all. I'm hardly an IEEE "Constitutional Scholar", but a few points stand out.

First of all there does not seem to be any straight amendment offered, only a compendium of changes in a number of formats integrated into the existing Constitution. Maybe this is okay given the complexity of the issue, but unless you look at everything it's a bit hard to understand.

Some other issues with the amendment as presented are:

- There seems to have been little real discussion or visibility into this amendment in local organizations.
- Dissenting comments cannot be presented from a group, but are attributed to a single member, reducing the impact of a group with the same dissent.
- Only one dissenter on individual points of disagreement is posted, in spite of the high probability that there are multiple views on each issue, both positive and negative.
- We are not privy to any of the internal discussions of the Board, so we do not know how they individually feel or how passionate is the defense or support for any element of this amendment.

Law, constitutional change and sausage have a lot in common as the old saying goes. It's a lot easier to sit back and simply consume the result. But it also suggests that you need to carefully read the ingredients and know a bit about the process. If the marketing materials look a little too slick, maybe it is best not to buy into it today and get smart first.

[https://www.ieee.org/about/corporate/election/2016\\_constitutional\\_amendment.html](https://www.ieee.org/about/corporate/election/2016_constitutional_amendment.html)

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So here's my bottom line - Please take a very careful look at this amendment before you vote.

If you have any doubts, vote No. Voting No doesn't make the change disappear forever, but it does let the framers know the issue needs to be thought out more and re-presented. The old constitution has served us well until now. We do not seem to be proposing solutions to urgent problems; more discussion over the next couple of years couldn't hurt anything. It might even convince some of us dissenters that this will make things better.

On the other hand if you totally agree that this is solving an urgent need for change, won't hurt, and won't get any better through more discussion and consideration, then you have the option of voting Yes.

It's all up to us, it really is.

Fausto Molinet, Past Chair of the Boston Section and Chair of the Boston Section Publications Committee

This year, the IEEE election includes an important amendment that alters the management structure of the IEEE.

Your review of this issue requires your attention as to how it impacts your membership.

In the August Digital Reflector, there are materials and some perspective on this Amendment.

The Constitutional Amendment which will be voted on in this year's election, I implore you so deeply read this Amendment and the included comments, as well as discuss it with your other IEEE colleagues.

Here, then, are links to a variety of background materials that could help you decide on your position on the impending amendment:

1. The proposed changes to the Constitution are posted at:  
[https://www.ieee.org/about/corporate/election/2016\\_constitutional\\_amendment.html](https://www.ieee.org/about/corporate/election/2016_constitutional_amendment.html)
2. Separately, information about the IEEEin2030 effort to evolve the IEEE organizational structure is posted at:  
[https://www.ieee.org/about/corporate/ieeein2030\\_archive\\_m.html](https://www.ieee.org/about/corporate/ieeein2030_archive_m.html)
3. There is also information on the amendment posted at:  
<https://ieeconstitutionamendment.wordpress.com/>
4. Those opposing the 2016 IEEE Constitutional Amendment have posted information why they are opposed at:  
<https://ieee2016blog.wordpress.com/>  
and  
<https://ieee2016blog.wordpress.com/category/opposition-statements/>
5. The IEEE governing documents, including the Constitution and Bylaws, are posted at:  
<http://www.ieee.org/about/corporate/governance/index.html>

When you vote on your ballot in August, please consider the impact on your membership and the future of the leadership of the IEEE.

Kevin Flavin  
2016 Chair, IEEE Boston Section

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

# Modern Topics in Power Amplifiers

**Times and Dates:** 6 - 8PM, Tuesdays, Sept. 27, Oct. 4, 11, 18, 25

**Location:** MIT Lincoln Laboratory, 5 Forbes Rd, Lexington, MA 02421

## Overview

This five week lecture series is intended to give a tutorial overview of the latest developments in power amplifier technology. It begins with a review of RF power amplifier concepts then teaches the modern MMIC design flow process. Efficiency and linearization techniques are discussed in the following weeks. The course is concluded with a hands on demonstration and exercise, brought to you by National Instruments, where participants will see how DPD and envelope tracking are implemented with actual hardware.,

## Target audience

The material is taught at a level that any electrical engineer should be able to understand. If your memory of RF amplifier concepts is a little rusty, make sure to catch the first lecture on September 27th.

## Goals/Benefits of attending

This course aims to give a broad overview of state-of-the-art PA techniques with practical hardware demonstrations.

## Schedule/Outline

### September 27th

Amplifier Basics, by Dr. Nestor Lopez of MIT Lincoln Laboratory

- RF Amplifier Characteristics
- Linearity
- Efficiency
- Modes of Operation
- LNA vs. HPA
- Amplifier Classes
- Amplifier Implementation
- Small Signal Theory
- Large-Signal Transistor Characterization

- Bias Networks
- Power Combining

### October 4th

MMIC Design Flow, by Dr. Youngho Suh of MIT Lincoln Laboratory

- Foundry selection with PDK availability
- Frontend Design
- Bias selection with loadline / loadpull, reliability
- Drive budget estimation for multi-stage cascade design
- Periphery estimation for target specification
- Matching topology selection
- Circuit Simulation
- Small signal linear simulation
- Large signal linear simulation (Cripps method)
- Large signal nonlinear simulation
- Layout and EM simulation
- Real estate war!
- Package interface
- 2 and 3D EM simulation tools
- Verification
- DRC and LVS
- Sensitivity, yields, stability...etc

### October 11th

High Efficiency Architectures, by Dr. Andrew Zai of MIT Lincoln Laboratory

- Fundamental Equations of Linearity and Efficiency
- Classes of Amplifiers and their Theoretical Efficiencies
  - Class A, AB, B, C
- Compression and Switched Mode PAs
  - Compression
  - Class D, Class F/F<sup>-1</sup>
- High Efficiency Architectures

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- Outphasing
- Doherty
- Envelope Tracking

Digital Transmitter, Dr. Rui Ma of Mitsubishi Electric Research Labs

- Class-S mode
- GaN for Digital TX
- Power encoding
- Delta-sigma Modulation
- Pulse Width Modulation
- Implementation of Digital TX
- FPGA
- ASIC

## October 18th

Predistortion Techniques, by Dr. Andrew Bolstad of MIT Lincoln Laboratory

- Why nonlinear systems?
- Linear vs. Nonlinear Systems
- Predistortion and Equalization
- Nonlinear System Models
- AM/AM and AM/PM
- Box Models
- Memory Polynomials and Generalized Memory Polynomials
- Volterra Kernels
- Pruned / Sparse Volterra Kernels
- Identification of Model Parameters
- Direct / Indirect Learning
- Training signals

Digital Predistortion System and Demo, by Dr. Kevin Chuang of NanoSemi, Inc.

- DPD System Architecture and Consideration
- Real-Time DPD Demonstration
- o Traditional Linearization based on Static DPD and Generalized Memory Polynomials
- o NanoSemi's Ultra-Wideband Proprietary Linearization
- Benefits of NanoSemi's Linearizer

## October 25th

Presentation and Hands on Hardware Demonstration from National Instruments on Digital Predistortion and Envelope Tracking

ET/DPD Measurement System Introduction

- o Instrumentation requirements for testing ET/DPD-enabled PA's
  - o [Hands-on] PA measurement walk-through (EVM, ACLR/SEM, AM-AM/AM-PM)
  - o [Demo] Effects of synchronization misalignment
  - o [Hands-on] ET shaping function
  - o [Hands-on] DPD model identification
- FPGA-based DPD reference design
- o Motivation
    - DPD potentially becoming a part of component test
    - Prototyping algorithms
  - o Software-based DPD algorithm considerations
    - Stimulus/response time, phase, amplitude alignment
    - Model extraction
  - o Overview of system platform
    - Vector Signal Transceiver (VST) architecture
    - A look at the instrument's DSP chain
  - o FPGA Algorithm
    - Predistorter implementation
    - Demo
    - Efficient time/phase/amplitude alignment algorithm
    - Demo
- Linearize your own PA
- o Attendee brings their own non-linear PA to test with measurement hardware

Light snacks will be provided

**Decision (Run/Cancel) Date for this Courses is Tuesday, September, 20, 2016**

**Payment received by September 15**

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$150</b> |
| <b>Non-members</b>  | <b>\$180</b> |

**Payment received after September 15**

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$180</b> |
| <b>Non-members</b>  | <b>\$195</b> |

<http://ieeeboston.org/modern-topics-power-amplifiers/>

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# Digital Signal Processing (DSP) for Wireless Communications - Under the Hood

**Time and Dates:** 6 - 9PM, Wednesdays, October 19, 25, November 2, 9, 16 (10/25 is a Tuesday)

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

**Speaker:** Dan Boschen, Microsemi

## Course Summary:

This course is a fresh view of the fundamental concepts of digital signal processing most applicable to practical real world problems and applications in radio communication systems. This course will build an intuitive understanding of the underlying mathematics through the use of graphics, visual demonstrations, and real world 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.

## 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 communications system design. With this, attendees will be able to implement more creative and efficient signal processing architectures in both the analog and digital domains

## Topics / Schedule:

### Class 1:

Correlation  
Fourier Transform  
Laplace Transform

### Class 2:

Sampling and A/D Conversion  
Z –transform  
D/A Conversion

### Class 3:

IIR and FIR Digital filters  
Direct Fourier Transform

### Class 4:

Windowing, Digital Filter Design  
Fixed Point vs Floating Point

### Class 5:

Fast Fourier Transform  
Multirate Signal Processing  
Multi-rate Filters

## 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 de-

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signing and developing transceiver hardware from baseband to antenna for wireless communications systems. Dan is currently at Microsemi (formerly 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/danboschen>

**Decision (Run/Cancel) Date for this Courses is  
Tuesday, October 11, 2016**

**Payment received by October 5**

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**<http://ieeeboston.org/digital-signal-processing-dsp-wireless-communications/>**

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

# Open Source Tools for Computational Biomechanics

**Times & Dates:** 8AM – 5PM, Thursday, September, 15, 2016**Location:** MIT Media Lab, Biomechatronics 75 Amherst Street Cambridge, MA 02139**Speakers:** Kevin Moerman, Centre for Extreme Bionics, MIT Media Lab.  
Steve Maas, University of Utah, Scientific Computing and Imaging Institute  
Christopher Dembia, Stanford University

## Overview

Computational biomechanics is a rapidly evolving field. New software tools have enabled detailed investigation of the biomechanical behavior of human soft tissue as well as the study of human motion and musculoskeletal biomechanics. These tools are now being used for patient-specific biomechanical analysis, medical device design, and rehabilitation research.

This course provides an introduction to a set of free and open source tools for computational biomechanics, namely GIBBON, FEBio and OpenSim. GIBBON provides a MATLAB framework for image segmentation, model construction and meshing. GIBBON also interfaces with FEBio, enabling advanced subject-specific and inverse finite element analysis. The OpenSim project allows one to simulate whole-body movements and estimate muscle activity, forces, and energetics.

Examples presented will include MRI based model creation, meshing, inverse material parameter estimation, patient specific medical device optimization. For a hands-on portion of the course participants will be invited to bring their own data, enabling them to initiate the use of the tools presented for their particular research areas.

The course will feature three speakers: Dr. Kevin Moerman (MIT Media Lab), GIBBON developer, Steve Maas (University of Utah), FEBio developer, and Christopher Dembia (Stanford University), who works

on the OpenSim project.

## Outline

- **Setting up the software environments**
- **GIBBON (The Geometry and Image-Based Bioengineering add-On)**
  - o Data and model visualization
  - o Image-based modelling
  - o Surface modelling and surfaces mesh improvement
  - o Surface and solid meshing techniques
  - o Finite element analysis and FEBio integration
- **FEBio (Finite Elements for Biomechanics)**
  - o Material models (hyperelastic, visco-hyperelastic, biphasic)
  - o Boundary conditions and contact modeling
  - o Analysis types (static, transient, dynamic)
  - o Plugin development
- **OpenSim**
  - o Estimating muscle activity from motion capture data
  - o Predictive simulation: combining optimization and simulation
  - o Survey of research studies combining OpenSim with finite element modeling.
- **Workshop and hands-on session**

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**Target Audience**

The course is targeted towards students, academics, and professionals in biomedical engineering, whose research involves soft tissue biomechanics.

**Benefits of Attending**

Attendees may benefit from the course by:

- 1) Being introduced to computational methods for soft tissue biomechanics (including image-based modeling, meshing, and finite element analysis).
- 2) Gaining hands-on experience in the use of free and open source software tools to solve problems in biomedical research

**Speakers' Bios**

**Kevin M. Moerman** is a biomechanical and design engineer. He holds a Bachelor in Mechanical Engineering, and a Masters and PhD in Bioengineering. He is currently program manager for mechanical interfaces at the Biomechatronics department of the MIT Media Lab, where he works on prosthetic socket design. He also holds a visiting research fellow position at Trinity College Dublin collaborating on computational modelling of soft tissue mechanical behavior. During his academic career he has amassed a wealth of computational tools for image-based modelling and inverse finite element analysis, resulting in the creation of his GIBBON open-source software project which he maintains on a voluntary basis. Kevin has shared his work at international conferences and is often involved in the organization of special sessions and workshops.

**Steve Maas** is a research associate at the University of Utah's Scientific Computing and Imaging Institute. He holds a Master's degree in Physics and is currently finishing his PhD in Computer Science. He is the lead software developer for the FEBio project, a finite element analysis package for soft tissue biomechanics, and has been an integral member of the project's development team since it started in 2006. Since then FEBio has grown into a new standard for finite element analysis in computational biomechanics. It offers tools that are highly relevant for the biomechanics and

bioengineering research communities and that are hard to come by in traditional finite element software. Another important aspect of the FEBio project is its focus on outreach to its users' community, which continues to grow and is currently thousands of members strong. Mr. Maas has presented numerous times on the use of FEBio and given workshops at several international conferences.

**Christopher Dembia** is a doctoral student at Stanford University in Prof. Scott Delp's Neuromuscular Biomechanics Lab. His research focuses on applying the latest optimal control methods to understand the effect of assistive devices on the metabolic cost of walking. He is also a core software developer for the OpenSim musculoskeletal modeling and simulation package, and works on incorporating the new optimal control methods into OpenSim. OpenSim was first released in 2007 as a GUI and a set of command line tools that allowed one to estimate muscle activity and forces from experimental data of a movement. Today, OpenSim allows users to develop their own custom studies and analyses via MATLAB, Python, and C++ interfaces. The OpenSim software is part of the National Center for Simulation in Rehabilitation Research, which provides workshops, pilot project grants, and webinars related to OpenSim.

**Materials for Course:** A course handout will be made available covering the course outline, and links the relevant GIBBON, FEBio, and OpenSim examples and documentation.

**Decision (Run/Cancel) Date for this Courses is Thursday, September 8**

**Payment received by September 5**

**IEEE Members \$150**

**Non-members \$185**

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**IEEE Members \$185**

**Non-members \$200**

<http://ieeeboston.org/open-source-tools-computational-biomechanics>

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# Making You a Leader - Fast Track

**Date & Time:** Wednesday, November 30; 8:30AM - 5:00PM

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

**Speaker:** Robin Goldsmith, President, GoPro Management

We do projects to make change. Yet, change will not occur without leadership, and leaders are rare. Leaders make others want to do what the leader wants done. Leaders cause ordinary people to achieve extraordinary things. Managing is not the same as leading, and titles do not make leaders. Seminars can teach you to manage, but they cannot teach you to be a leader. Rather, making a leader takes special techniques—such as our personal development clinics—that can change deep-seated behaviors learned over a lifetime.

However, since clinics usually last about ten weeks, this mini-clinic was devised as a more convenient alternative. This format places responsibility upon the participant to carry out an extended informal follow-on program after completion of the formal seminar workshop session.

During the follow-on period, the participant uses time-condensed methods that simulate the lifetime learning which makes a leader. Therefore, commitment to carrying out these exercises is essential for successful transformation.

## Participants will learn:

- Leadership characteristics and practices that are essential for project and personal success.
- Differences between management and leadership, how they conflict, and why leaders are so rare.
- Behaviors leaders use to influence others, up and down, to want to do what the leader wants them to do
- Special techniques personal development clinics

use to change lifetime learning and make leaders.

- How to employ those special techniques in a follow-on mini-clinic to develop the leadership skills they need to make their projects successful.

**WHO SHOULD ATTEND:** This course has been designed for business and systems professionals who want to improve their ability to lead and influence other people.

## LEADERSHIP CHARACTERISTICS & ROLE

How leadership looks and feels

Management vs. leadership

Leadership components of project success

Basic leadership practices; power sources

Real change leaders in organizations

## TEAMS AND LEADERSHIP

Everyone feels leadership is lacking

Everyone thinks s/he is a leader

Results, not actions or intent

Workgroups, teams, and leaders

Situational leadership styles

Coaching and sports analogies to projects

## INSPIRING AND MOTIVATING

Gaining commitment to project success

Communicating that influences others

Addressing negativism and groupthink

Conscious and unconscious messages

Greatest management principle

Hierarchy of needs effects on projects

Hygiene factors vs. motivators

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Helping project players get their rewards  
 Influencing up and down without authority  
 Inspiring the extra efforts projects need  
 Energizing the project team

### SHARED VISIONS

Relating values and vision to projects  
 Getting others to embrace one's vision  
 Developing a motivating project vision

### WHERE AND HOW LEADERS ARE MADE

Born or made? How do we know?  
 Habits of thought that affect project success  
 Overcoming self-limiting lifetime learning  
 Leader's critical success factors  
 Traditional education doesn't make leaders  
 Special way—personal development clinics

### SETTING AND ACCOMPLISHING GOALS

S.M.A.R.T. goals for self and project  
 Action plans to achieve your goals  
 Visualizing and emotionalizing

### DEFINING THE FOLLOW-ON PROGRAM

Clarifying project leadership objectives  
 Breaking into prioritized subgoals  
 Establishing rewarding daily achievements  
 Special techniques to change habits

### CARRYING OUT THE MINI-CLINIC

Working with a follow-up support structure  
 Mapping results regularly to goals  
 Objectively recording leadership changes  
 Self-leadership through the process

**Speaker's Bio:** Robin F. Goldsmith, JD is an internationally recognized authority on software development and acquisition methodology and management. He has more than 30 years of experience in requirements definition, quality and testing, development, project management, and process improvement. A frequent featured speaker at leading professional conferences and author of the recent Artech House book, *Discovering REAL Business Requirements for Software Project Success*, he regularly works with and trains business and systems professionals.

**Decision (Run/Cancel) Date for this Courses is  
 Friday, November 18, 2016**

#### **Payment received by November 11**

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| <b>IEEE Members</b> | <b>\$220</b> |
| <b>Non-members</b>  | <b>\$245</b> |

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# Defining and Writing Business Requirements

**Date & Time:** Monday & Tuesday, December 5 & 6; 8:30AM - 5:00PM

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

**Speaker:** Robin Goldsmith, President, GoPro Management

Discovering and documenting business requirements for projects always has been the weakest link in systems development. Up to 67 percent of maintenance and 40 percent of development is wasted rework and creep attributable to inadequately defined business requirements. Too often projects proceed based on something other than what the business people really need; and traditional methodologies commonly focus mainly on the format for writing requirements. This interactive workshop also emphasizes how to discover content, why to build it and what it must do to produce value for the customer/user. Using a real case, participants practice discovering, understanding, and writing clear and complete business/user requirements that can cut creep, speed project delivery, reduce maintenance, and delight customers

Participants will learn:

- Avoiding creep--role and importance of defining business requirements accurately and completely.
- Distinctions between the user's (business) requirements and the system's (design) requirements.
- How to gather data, spot the important things, and interpret them meaningfully.
- Using the Problem Pyramid™ tool to define clearly problems, causes, and real requirements.
- Formats for analyzing, documenting, and communicating business requirements.
- Techniques and automated tools to manage requirements changes and traceability.

**WHO SHOULD ATTEND:** This course has been designed for systems and business managers, project leaders, analysts, programmer analysts, quality/testing professionals, auditors, and others responsible for assuring business requirements are defined adequately.

## REQUIREMENTS ROLE AND IMPORTANCE

- Sources and economics of system errors
- How requirements produce value
- Business vs. system requirements
- Survey on improving requirements quality
- Software packages and outsourcing
- How we do it now vs. what we should do

## DISCOVERING "REAL" REQUIREMENTS

- Do users really not know what they want?
- How the "real" requirements may differ
- Aligning strategy, management, operations
- Technology requirements vs. design
- Problem Pyramid™ tool to get on track
- Understanding the business needs/purposes
- Horizontal processes and vertical silos
- Customer-focused business processes
- Who should do it: business or systems?
- Joint Application Development (JAD) limits
- Management/supervisor vs. worker views

## DATA GATHERING AND ANALYSIS

- Surveys and questionnaires

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Research and existing documentation  
 Observing/participating in operations  
 Prototyping and proofs of concept  
 Planning an effective interview  
 Controlling with suitable questions  
**FORMATS TO AID UNDERSTANDING**  
 Business rules, structured English  
 E-R, data flow, flow, organization diagrams  
 Data models, process maps  
 performance, volume, frequency statistics  
 Sample forms, reports, screens menus

**DOCUMENTATION FORMATS**  
 IEEE standard for software requirements  
 Use cases, strengths and warnings  
 7 guidelines for documenting requirements  
 Requirements vs. implementation scope  
 Iterating to avoid analysis paralysis  
 Conceptual system design solutions  
 Detailing for clarity, clarifying quality

**GETTING MORE CLEAR AND COMPLETE**  
 Stakeholders and Quality Dimensions  
 Addressing relevant quality factor levels  
 Standards, guidelines, and conventions  
 Detailing Engineered Deliverable Quality  
 Simulation and prototyping  
 Defining acceptance criteria

**MANAGING THE REQUIREMENTS**  
 Supporting, controlling, tracing changes  
 Automated requirements management tools  
 Measuring the “proof of the pudding”

**Speaker’s Bio:**

Robin F. Goldsmith, JD is an internationally recognized authority on software development and acquisition methodology and management. He has more than 30 years of experience in requirements definition, quality and testing, development, project management, and process improvement. A frequent featured speaker at leading professional conferences and author of the recent Artech House book, *Discovering REAL Business Requirements for Software Project Success*, he regularly works with and trains business and systems professionals.

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# Credibly Managing Agile and Other Projects

## Skills, Approaches and Methods Needed to Make any Project Succeed!

**Date & Time:** Monday & Tuesday, November 28 & 29; 8:30AM - 5:00PM

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

**Speaker:** Robin Goldsmith, President, GoPro Management

Despite claims to the contrary, even Agile projects need to be managed in order to succeed. That doesn't—and never did—mean the project manager dictates every little action; but every project must know what to do, how to do it, what it takes, and how to make sure it gets done well. Agile methods help but are not sufficient and can create challenges.

This intensive interactive seminar workshop shows how to manage projects to deliver the results their customers want, on time and in budget. This course helps improve project teams' credibility by better knowing what they're doing so they deliver as promised. Each section of the course shows how to make sure that an additional Critical Success Factor is present and addresses both Agile and other project formats. Case study exercises provide practice applying the techniques and learning how to avoid common pitfalls.

Participants who attend this course may also want to attend "Making You a Leader."

- \* How lack of credibility often unknowingly affects project success and ways to earn credibility.
- \* Recognizing and avoiding common, often overlooked pitfalls to on-time, in-budget, quality projects.
- \* Using Agile and other development life cycles to jump-start projects confidently and quickly.
- \* Defining scope so it doesn't creep and building essential transitions to the workplan for achieving it.
- \* Methods for reliably estimating the time, effort, costs, and resources required.
- \* Controlling risks and balancing conflicts in the real world of both task and resource constraints.

\* Tools and techniques to catch and correct problems early so project promises are kept.

**WHO SHOULD ATTEND:** This course has been designed for business and development specialists, product owners, scrum masters, managers, analysts, and other project participants.

### CRITICAL PROJECT SUCCESS FACTORS

Importance of credibility to project success

Characteristics of successful projects

Factors that really cause projects to fail

Agile's view, why no project manager

Superworker to supervisor to superfluous

Establishing credibility, managing by facts

Overcoming Parkinson's Law

Projects succeed/fail in the first 15 minutes

### PROJECT LIFE CYCLE

Mapping project management/development

Why we get impossible deadlines/budgets

Traditional and iterative, Agile models

Project management deliverables

System development deliverables

Proactive Testing □ developer's advantage

### ANALYST/DESIGNER ROLE

Establishing achievable project scope

Internal & external customers/stakeholders

Strategic and management alignment

Identifying project risks

Requirements, design, user stories, ATDD

Make vs. buy

JAD, facilitation, and customer partnering

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High-level conceptual design roadmap

#### ESTIMATING TIME, EFFORT, RESOURCES

Understanding causes of poor estimates  
 Applying multiple estimating strategies  
 Work breakdown structure, controlling risk  
 Measuring deliverables, function points  
 User story sizing, backlog grooming  
 PERT and weighted averages risk reduction  
 Cost/benefit analysis and communication

#### SCHEDULING TO MEET DEADLINES

Productive time scheduling practicalities  
 Time management techniques  
 Dependency networking and CPM  
 Coordinating multiple projects/resources  
 Sprints, releases, strengths and issues  
 Managing resource-constrained projects  
 Working within Brooks' Law  
 Negotiating commitments and resources

#### CONTROLLING PROJECT COMPLETIONS

Monitoring against budget and schedule  
 Time boxing, burn down charts  
 Earned value measure of completion  
 Assuring quality and preventing errors  
 Automated tools, Kanban boards  
 Reporting to stakeholders, management  
 Key to advancement

#### **Speaker's Bio:**

Robin F. Goldsmith, JD is an internationally recognized authority on software development and acquisition methodology and management. He has more than 30 years of experience in requirements definition, quality and testing, development, project management, and process improvement. A frequent featured speaker at leading professional conferences and author of the recent Artech House book, *Discovering REAL Business Requirements for Software Project Success*, he regularly works with and trains business and systems pro-

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Our time line is to have the online curriculum operational by September 2017.

- Intro to Embedded Linux • Linux Optimization • Making you a Leader • DSP for Wireless Comm
- Forensics • S/W for Medical Devices • Verilog • Project Management • Linux Android

Please check our website, e-reflector and this Digital Reflector for details moving forward

Please take this short survey, <https://www.surveymonkey.com/r/B8R2DYL>

# Introduction to Embedded Linux

**Time & Date:** 6 - 9PM; Thursdays, Nov. 10, 17, Wednesdays, Nov. 30, Dec. 7

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

**Speaker:** Mike McCullough, RTETC, LLC

**Overview** - This 4 day course introduces the Linux Operating System and 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 of the course covers testing, booting and configuring of Embedded Linux systems 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 understand the complexities of Embedded Linux Distributions in embedded systems.
  - To learn how to configure, boot and test Embedded Linux distributions and applications running on Embedded Linux target systems.
  - To give students the 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
- 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

**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 development tools, training and consulting for the embedded systems market.

## OUTLINE

### Course Schedule Day 1

The Basics

Linux Terminology, History and Versioning

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The Linux Community: Desktop & Embedded  
 Linux and the GPL  
 Linux References (Books and Online)  
 Getting Started  
 Building the Kernel Source Code  
 Embedded Linux Kernels  
 Linux 2.6 and 3.x  
 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, GDB Server and the GDB Server Debugger  
 Other Debug and Test Tools  
 An Eclipse Remote Debug Example  
 Advanced Debug with printk, syslogd and LTTng  
 System-Level Debug  
 System-Level Debug Tools  
 The /proc Filesystem  
 Advanced Logging Methods  
 KGDB and KDB  
 Crash and Core Dumps

## Course Schedule Day 2

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  
 Condition and Completion Variables  
 Mutexes and Futexes  
 Inter-Process Communications (IPC)  
 Message Queues  
 Semaphores Revisited  
 Shared Memory  
 Pipes and FIFOs  
 Remote Procedure Calls  
 Networking

## Course Schedule Day 3

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  
 Advanced Memory Operations  
 Linux and Memory  
 Managing Aligned Memory  
 Anonymous Memory Mappings  
 Debugging Memory Allocations  
 Locking and Reserving Memory  
 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)  
 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  
 Major and Minor Numbers  
 Configuring the Device Driver

The Evolution of the New Device Driver Model  
 The Initial Object-Oriented Approach  
 Platform Devices, Busses, Adapters and Drivers  
 Comparing the Two Driver Models

**Course Schedule Day 4**

Advanced I/O Operations  
 Standard I/O Operations  
 Scatter-Gather and Asynchronous I/O  
 Poll, Select and Epoll  
 Memory-Mapped I/O  
 File Advice  
 I/O Schedulers  
 Interrupt and Exception Handling  
 Bottom Halves and Deferring Work  
 The Linux Boot Process  
 The Root Filesystem  
 Desktop Linux Boot  
 Bootloaders and U-Boot  
 Embedded Linux Boot Methods  
 Building and Booting from SD Cards  
 Managing Embedded Linux Builds  
 Configuring and menuconfig  
 Building Custom Linux Images

Target Image Builders  
 LTIB and Yocto  
 System Architecture Design Approaches  
 Deploying Embedded Linux  
 Choosing and Building the Root Filesystem  
 Useful Embedded Filesystems  
 Module Decisions  
 Final IT Work  
 Embedded Linux Trends  
 Some Final Recommendations

**Decision (Run/Cancel) Date for this Courses is  
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The IEEE Boston Section is in the process of creating an comprehensive online course presence. We are working to populate our online course offerings with several courses.

Our time line is to have the online curriculum operational by September 2017.

- Intro to Embedded Linux • Linux Optimization • Making you a Leader • DSP for Wireless Comm
- Forensics • S/W for Medical Devices • Verilog • Project Management • Linux Android

Please check our website, e-reflector and this Digital Reflector for details moving forward

Please take this short survey, <https://www.surveymonkey.com/r/B8R2DYL>



# Early Registration Discount Deadline; September 19. Register now and Save!!!!!!!!!!!!!!



## 2016 IEEE International Symposium on Phased Array Systems and Technology Revolutionary Developments in Phased Arrays



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**18–21 October 2016**

Westin Waltham Hotel, Greater Boston, Massachusetts, USA

[www.array2016.org](http://www.array2016.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.

### Plenary Session Speakers

- **William Delaney** – MIT Lincoln Laboratory
- **Troy Olsson** – DARPA
- **Israel Lupa** – IAI ELTA, Israel
- **Gordon Frazer** – DSTO Australia
- **Joseph Haimerl** – Lockheed Martin
- **Tony Fischetti** – Northrop Grumman Corp.



### SESSIONS

|                                               |                                        |
|-----------------------------------------------|----------------------------------------|
| Plenary                                       | Signal Processing and Architectures    |
| European Phased Array Systems and Technology* | Dual Polarization Weather Radar Arrays |
| Array Design I, II, III                       | Multifunction Arrays                   |
| T/R Modules                                   | Millimeter Wave and Terahertz Arrays*  |
| Radar I, II                                   | Metamaterial Phased Arrays*            |
| Beamforming and Calibration I, II, III        | MIMO Arrays                            |
| Emerging Technologies for Wideband Arrays*    | Conformal Arrays                       |
| Communications Arrays                         | Poster Sessions I & II                 |
| Array Measurements                            |                                        |

\*Special Session

### Tutorials

- **Phased Arrays for MIMO Radar**  
*Dr. Vito Mecca, MIT Lincoln Laboratory*
- **Smart Antennas**  
*Dr. Frank Gross, Boeing Technical Fellow, Georgia Southern University*
- **T/R Modules for Phased Arrays**  
*Dr. William H. Weedon, Applied Radar*
- **Phased Array Antenna Measurements**  
*Dr. Alan J. Fenn, MIT LL*
- **Advances in SiGe BiCMOS Technology with Chip Scale Phased Array Applications**  
*– Dr. Gabriel Rebeiz, UCSD*
- **Phased Arrays for Imaging Applications**  
*Dr. Carey Rappaport, Northeastern University*
- **Microwave Array Beamforming: Analog, Digital, and Photonic**  
*Dr. Jeffrey Herd, MIT Lincoln Laboratory*
- **Phased Arrays: Basics, Breakthroughs & Future Trends**  
*Dr. Eli Brookner, Raytheon (Retired)*

### Conference Committee

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Hans Steyskal, Arcon

Chris McCarroll, Raytheon

# Advanced Embedded Linux Optimization

**Time & Date:** 6 - 9PM, Mondays, January 9, 16, 23, 30, 2017

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

**Speaker:** Mike McCullough, RTETC, LLC

**Course Summary** - This 4-day technical training 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 methods for debugging, profiling and testing 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.

## OUTLINE

### Course Schedule Day 1

Getting Started with Embedded Linux  
Linux and the GPL  
Building the Kernel Source Code  
Embedded Linux Kernels  
BSPs and SDKs

### Linux References (Books and Online)

Basic Debugging Review  
Embedded Applications Debugging  
GDB, GDB Server and the GDB Server Debugger  
An Eclipse Remote Debug Example  
Debugging with printk and LTTng  
System Logs  
Other Debuggers  
System-Level Debug  
System-Level Debug Tools  
The /proc and /sys Filesystems  
Basic Logging  
KGDB and KDB  
Crash Dumps and Post-Mortem Debugging  
Debugging Embedded Linux Systems  
Backend Debuggers  
JTAG and In-Circuit Emulators  
Hardware Simulators  
Analyzers  
Debugging Device Drivers  
Kernel Probes  
Kexec and Kdump  
Kernel Profiling

### Course Schedule Day 2

Testing  
Design for Test  
Agile Software Design  
Unit-Level Testing  
System-Level Testing  
Code Coverage Tools  
gcov  
Automated Testing  
DebugFS  
Configuring DebugFS  
DebugFS Capabilities  
Advanced Logging  
LogFS  
Using Logwatch and Swatch  
Using syslogd and syslog-ng

- Kernel Hacking
- Configuring Kernel Hacking
- Kernel Hacking Capabilities
- Tracing
- ptrace and strace
- New Tracing Methods
- SystemTap
- Ftrace, Tracepoints and Event Tracing
- Tracehooks and utrace

### **Course Schedule Day 3**

- Profiling
- Basic Profiling
- gprof and Oprofile
- Performance Counters
- LTTng
- Another DDD Example
- Manual Profiling
- Instrumenting Code
- Output Profiling
- Timestamping
- Measuring Embedded Linux Performance
- Some Ideas on Performance Measurement
- Common Considerations
- Uncommon Considerations
- Using JTAG Methods
- BootLoader Optimizations
- Boot Time Measurements
- Effective Memory and Flash Usage
- Filesystem Choices
- Addressing Performance Problems
- Types of Performance Problems
- Using Performance Tools to Find Areas for Improvement
- Application and System Optimization
- Device Driver Optimization
- CPU Usage Optimization
- Memory Usage Optimization
- Disk I/O and Filesystem Usage Optimization
- The Perf Tool
- 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
- Performance Tool Assistance
- Recording Commands and Performance

- System Error Messages and Event Logging
- Dynamic Probes
- User Mode Linux and Virtualization

### **Course Schedule Day 4**

- 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

**Decision (Run/Cancel) Date for this Courses is  
Friday, December 30, 2016**

#### **Payment received by December 27**

**IEEE Members      \$395**

**Non-members      \$415**

#### **Payment received after December 27**

**IEEE Members      \$415**

**Non-members      \$435**

<http://ieeeboston.org/advanced-embedded-linux-optimization/>

Please take this short survey, <https://www.surveymonkey.com/r/B8R2DYL>

# Embedded Linux Board Support Packages and Device Drivers

**Date & Time:** 6 - 9PM; Mondays, Nov. 28, Dec. 5, 12, 19

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

**Speaker:** Mike McCullough, RTETC, LLC

**Course Summary** - This 4-day technical training course provides advanced training in the development of Embedded Linux Board Support Packages (BSPs), Device Drivers and Distributions. 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 USB 3.0 and PCIe
- To give students the confidence to apply these concepts to their next Embedded Linux project.

## Course Schedule Day 1

Getting Started with Embedded Linux  
Linux and the GPL  
Building the Kernel Source Code  
Embedded Linux Kernels

BSPs and SDKs

Linux References (Books and Online)

Embedded Linux BSP Development Basics  
BSP Requirements  
U-Boot and Bootloader Development  
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 Handling in BSPs  
BSP Deployment Issues and Practices  
Embedded Linux SDK Basics  
The 3 Pieces of an SDK  
Embedded Linux Distributions  
The GNU Compiler Collection (GCC)  
Other Embedded Linux Development Tools  
Library Support  
Glibc and Alternatives  
SDK Deployment and Support  
Debugging  
GDB, GDB Server and the GDB Server Debugger  
Other Debug Tools  
An Abatron Board Bring-Up Example  
An Eclipse Remote Debug Example  
Advanced Debug with printk, syslogd and LTTng  
System-Level Debug  
System-Level Debug Tools  
The /proc Filesystem  
Advanced Logging Methods  
KGDB and KDB  
Crash Dumps

## Course Schedule Day 2

Configuring Embedded Linux  
Config Methods  
Config Syntax  
Adding Code to the Linux Kernel  
  
Booting Embedded Linux  
The Linux Boot Process

Please take this short survey, <https://www.surveymonkey.com/r/B8R2DYL>

NFS and RAMdisk Booting  
 Root and Flash File System Development  
 Building the RAMdisk  
 Busybox Development  
     Testing and Debug of Embedded Linux BSPs  
 Kernel Debug and Kernel Probes  
 Kexec and Kdump  
 The Linux Test Project (LTP)  
 Performance Tuning Embedded Linux BSPs  
 User Mode Linux and Virtualization  
 Measuring Embedded Linux BSP Performance  
 Common Considerations  
 Uncommon Considerations  
 BootLoader Optimizations  
 Boot Time Measurements  
 Effective Memory and Flash Usage  
 Filesystem Performance Issues  
 Some Ideas on Performance Measurement

## Course Schedule Day 3

    The Original Device Driver Model  
 The fops struct and Char Drivers  
 The inode and dentry structs  
 Major and Minor Numbers  
 Embedding Channel Information  
 Deferring Work  
 The /proc Filesystem  
  
 Configuring the Device Driver  
 Modularization Revisited  
     The New Device Driver Model  
 An Object-Oriented Approach  
 Platform Devices and Drivers  
 Subsystem Registration  
 The Probe and Init Functions  
 The Show and Store Functions  
 The /sys Filesystem  
 Configuring the New Device Driver  
     Comparing the Two Driver Models  
 The Flattened Device Tree (FDT)  
 openBoot and its Effect on Embedded Linux  
 The Device Tree Script (dts) File  
 The Device Tree Compiler (dtc)  
 The Device Tree Blob (dtb) File  
 Building a dtb File  
 Hybrid Device Drivers  
 Other fops Functions  
 The Need for ioctl  
 A Simulated Char Device Driver  
 The SIM Device Driver  
 Initialization  
 Open and Close  
 Read and Write  
 The /proc Driver Interface  
 MMAP Support

## Course Schedule Day 4

Linux Device Driver Subsystems  
 Serial Drivers  
 The RTC Subsystem  
 Watchdogs  
 I2C & SPI  
 Block Devices  
 PCI  
 USB  
 VME  
 Video  
 Sound  
 What's Missing?  
 Memory Technology Devices  
 What is an MTD?  
 NAND vs NOR Flash Interfaces  
 The Common Flash Interface (CFI)  
 Driver and User Modules  
 Flash Filesystems  
 Drivers in User Space  
 Accessing I/O Regions  
 Accessing Memory Regions  
 User Mode SCSI, USB and I2C  
 UIO  
 High-Speed Interconnects  
 PCIe  
 GigE  
 iSCSI  
 Infiniband  
 FibreChannel  
 Serial RapidIO  
 Debugging Device Drivers  
 kdb, kgdb and JTAG  
 Kernel Probes  
 Kexec and Kdump  
 Kernel Profiling  
 User Mode Linux and Kernel Hacking  
 Performance Tuning Device Drivers  
 Some Final Recommendations

**Decision (Run/Cancel) Date for this Courses is  
 Friday, November 18 2016**

### Payment received by November 15

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$395</b> |
| <b>Non-members</b>  | <b>\$415</b> |

### Payment received after November 15

|                     |              |
|---------------------|--------------|
| <b>IEEE Members</b> | <b>\$415</b> |
| <b>Non-members</b>  | <b>\$435</b> |

<http://ieeeboston.org/embedded-linux-bsp-device-drivers/>

Please take this short survey, <https://www.surveymonkey.com/r/B8R2DYL>



# Attention: RF, Microwave, & High-Speed Digital Designers



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**[www.ediconusa.com](http://www.ediconusa.com)**

## IEEE MIT Call for Submissions

Submission Deadline: September 3<sup>rd</sup>, 2016



### Meet Innovation Technology

Sponsored by MIT IEEE Student Branch and IEEE Boston Section

MIT IEEE Student Branch believes a technical conference is needed for all the undergraduate students globally. They inaugurated the IEEE MIT Undergraduate Research Technology Conference last year, and will organize it again for this year. MIT will be the venue where the undergraduate students can meet to present, discuss, and develop solutions to advance technology for humanity. Participants can attend a rich program with renowned speakers, technical sessions, student design competition, exhibits, networking and social activities. It is a great opportunity for students to interact with the industry experts.

The conference theme is “Meet Innovation Technology (MIT)”, and the four focus technical tracks are:

1. Big Data, Cloud Computing, Cybersecurity
2. Life Sciences, Biomedical Engineering and Technology
3. Robotics and Automation Technology
4. Communications for All Things
5. Wearable Technology
6. Innovative Technologies X-Track

Authors may submit content in the form of a technical paper, poster, or lightning talk.

All submissions must be written in English. Paper submissions must not be longer than 4 pages. Minimum font is 10 point, single-spaced, and submissions may include figures, illustrations, and graphs. Abstract submission for poster and lightning talk will be limited to 500 words.

All submissions will be peers reviewed. Notification of acceptance or rejection will be sent via email.

Submission will be online, and deadline is September 3<sup>rd</sup>, 2016. Notification of acceptance by September 24, 2016.

Please join the mailing list ([MIT-Conference@ieee.org](mailto:MIT-Conference@ieee.org)) for more information on the submission, technical program, registration, and accommodation.

Conference Proceeding of all the accepted papers that have been presented at the conference may be published, and included in the IEEE Xplore. Electronic media and online containing all accepted submissions will be distributed to the registered attendees.

For any inquiries, please email either the conference co-chair: - Alice Zhan ([tzhan@mit.edu](mailto:tzhan@mit.edu)) or Helen Zhou ([hlzhou@mit.edu](mailto:hlzhou@mit.edu)).

<http://ieee.scripts.mit.edu/conference>



**Massachusetts  
Institute of  
Technology**



Please take this short survey, <https://www.surveymonkey.com/r/B8R2DYL>

## 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 [sec.boston@ieee.org](mailto:sec.boston@ieee.org) 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.

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# Note New Submission Schedule

## Call for Papers, Posters, and Tutorials

### 2017 IEEE International Symposium on Technologies for Homeland Security

25–26 April Westin Hotel, Waltham, MA  
<http://ieee-hst.org/>



#### Call for Papers, Posters & Tutorials

The 16th annual IEEE Symposium on Technologies for Homeland Security (HST '17), will be held 25-26 April 2017, in the Greater Boston, Massachusetts area. This symposium brings together innovators from leading academic, industry, business, Homeland Security Centers of Excellence, and government programs to provide a forum to discuss ideas, concepts, and experimental results.

Produced by IEEE with technical support from DHS S&T, IEEE, IEEE Boston Section, and IEEE-USA and organizational support from MIT Lincoln Laboratory, Raytheon, Battelle, and MITRE, this year's event will once again showcase selected technical paper and posters highlighting emerging technologies in the areas of:

#### Cyber Security

#### Biometrics & Forensics

#### Land and Maritime Border Security

#### Disaster and Attack Preparedness, Mitigation, Recovery, and Response

We are currently seeking technical paper, poster and tutorial session submissions in each of the areas noted above. Papers examining the feasibility of transition to practice will also be considered. Submissions should focus on technologies with applications available for implementation within about five years. All areas will cover the following common topics:

- Strategy and threat characterization, CONOPs, risk analysis,
- Modeling, simulation, experimentation, and exercises & training, and
- Testbeds, standards, performance and evaluations.

#### Contact Information

For more detailed information on the Call for Papers, Posters & Tutorials, as well as Sponsorship and Exhibit Opportunities, visit the website <http://ieee-hst.org/> or email: [information@ieee-hst.org](mailto:information@ieee-hst.org). Submissions should be made at the following website: <https://cmt3.research.microsoft.com/HST2017/>

#### Important Dates

|                                                    |                  |
|----------------------------------------------------|------------------|
| Paper Abstract Deadline:                           | October 17, 2016 |
| Paper, Poster and Tutorial Acceptance Notification | December 1, 2016 |
| Final Paper Submission Deadline:                   | March 1, 2017    |

*All deadlines are by midnight Eastern Time.*

#### Organizing Committee

|                               |                                        |
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| Tutorials Chair:              | Anthony Serino, Raytheon               |
| Business Program Chair:       | Andrea Marsh, Battelle                 |
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| Marketing Chair:              | Jessica Patel, Raytheon                |
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| Sponsorship/Exhibits Chair:   | Fausto Molinet, Matrix Internationale  |
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| Registration Chair:           | Karen Safina, IEEE Boston              |

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|                                                                                           |
|-------------------------------------------------------------------------------------------|
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| <i>Biometrics &amp; Forensics</i>                                                         |
| Eric Schwoebel, MIT Lincoln Laboratory James L. Wayman, San Jose State University         |
| <i>Land and Maritime Border Security</i>                                                  |
| Karen Panetta, Tufts University Rich Moro, Raytheon John Aldridge, MIT Lincoln Laboratory |
| <i>Cyber Security</i>                                                                     |
| Claire Applegarth, Mark Peters, MITRE                                                     |

## 2016 IEEE High Performance Extreme Computing Conference

(HPEC '16)

Twentieth Annual HPEC Conference

13 - 15 September 2016  
Westin Hotel, Waltham, MA

www.ieee-hpec.org



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## Demos



## About the Conference

HPEC is the largest computing conference in New England and is the premier conference in the world on the convergence of High Performance and Embedded Computing. We are passionate about performance. Our community is interested in computing hardware, software, systems and applications where performance matters. We welcome experts and people who are new to the field.

## Keynote Speaker

- Mr. David Martinez (HPEC Founder; IEEE Fellow; MIT Lincoln Laboratory Associate Head Cyber Security & Information Sciences Division) - HPEC: The Past, Present and Future Outlook

## Invited Speakers

- Prof. Gilbert Strang (National Academy of Sciences; SIAM Fellow; MIT Mathematics Department) - Finding the Important Part of a Matrix or Graph
- Mr. Trung Tran (DARPA MTO - Program Manager) - Machine Learning, Data Analytics, and Non-Conventional Computer Architecture
- Dr. Jennifer Roberts (DARPA I20 - Program Manager) - The Future of Scalable Analytics and Machine Learning
- Mr. Robert Bond (MIT Lincoln Laboratory Associate Head ISR Systems & Technology Division) - Future DoD Computing and the Emergence of Autonomous Systems
- Prof. Aleksander Madry (MIT Computer Science & AI Laboratory) - Linear-Algebraic Methods in Algorithmic Graph Theory
- Prof. Orran Krieger (Boston University Cloud Computing Initiative) - The Massachusetts Open Cloud: Vision and Early Experiences
- Prof. Martin Herbordt (Boston University Electrical & Computer Engineering Department) - TBD
- Prof. Viktor Prasanna (USC Charles Lee Powell Chair in Engineering) - TBD
- Prof. Nir Shavit (MIT Computer Science & AI Laboratory) - High Throughput Connectomics: The Building of a Brain-Scope
- Dr. Robert Cunningham (Chair IEEE Cybersecurity Initiative; MIT Lincoln Laboratory Group Leader Secure Resilient Systems & Technology) - End-to-End Security in the Cloud
- Dr. Igor Linkov (U.S. Army Corps of Engineers) - Cyber/Physical Resilience
- Mr. Clair Grant (Director of R&D VMS Software, Inc) - OpenVMS: 40 Years of Mission Critical Computing

## Special Events

- BigDAWG Big Data Working Group; organizers: Dr. Tim Mattson (Principal Engineer - Intel) & Dr. Vijay Gadepally (MIT Lincoln Laboratory Supercomputing Center)
- GraphBLAS forum to define standard building blocks for graph algorithms; organizers: Prof. John Gilbert (SIAM Fellow; UC Santa Barbara) & Dr. Scott McMillan (CMU Software Engineering Institute)
- Massachusetts High Performance Computing; organizers: Dr. Chris Hill (Principal Research Engineer - MIT) & Prof. Patrick Dreher (North Carolina State)
- Vector, Signal, and Image Processing Library (VSIPL) standard working group; organizer: Prof. Tony Skjellum (Director - Auburn University Cyber Research Center)
- Tools for Quantum Computing; organizers: Mr. Steve Reinhardt (D-Wave Systems) & Dr. John Cortese (MIT Lincoln Laboratory)
- Secure and Resilient Computing; organizers: Dr. Michael Vai (MIT Lincoln Laboratory Secure Resilient Systems & Technology) & Dr. George Kalb (JHU Information Security Institute)
- RISC-V; organizer: Mr. Kurt Keville (MIT ISN)

## Tutorials

- Securing Your Embedded Systems for Cyberspace; instructors: Dr. Michael Vai, Dr. Roger Khazan & Mr. Benjamin Nahill (MIT Lincoln Laboratory Secure Resilient Systems & Technology)
- OpenMP programming; Dr. Tim Mattson (Principal Engineer - Intel)
- Mathematics of Big Data: Spreadsheets, Databases, Matrices, and Graphs; organizer: Dr. Jeremy Kepner (MIT Lincoln Laboratory Supercomputing Center)

## Committee

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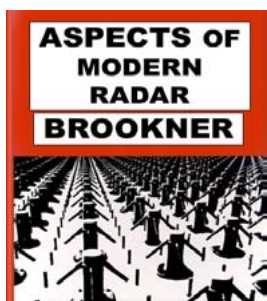
# Radar Basics and Amazing Recent Advances

**Time & Dates :** 6:00 - 9:00 PM, Mondays, Oct. 24, 31, Nov. 7, 14, 21, 28, Dec. 5, 12, 19 2016, Jan. 9, 2017 (If needed, Snow/make up days Jan. 23, 30, Feb. 6)

**Location:** MITRE Corporation, 202 Bedford Rd., Burlington (tentative)

**Speaker:** Dr. Eli Brookner, Raytheon Company (Retired)

*All Attendees of the class will receive a trial license of MATLAB, Phased Array System Toolbox, and Antenna Toolbox from MathWorks in addition to a set of examples which help demonstrate the key radar concepts covered in the course material.*



The following book plus over ten paper reprints are provided FREE with your registration:

1. "Aspects of Modern Radar", Dr. Eli Brookner (Editor), Artech House, Hardcover, 432 pages, 1988, List price: \$159. The 1st chapter gives the best easy to read introduction to radar. It covers all aspects of radar: transmitters, receiver, antennas, signal processing, tracking, clutter derivation of radar equation in easy terms and definition of dB. The 2nd chapter gives detailed descriptions of different radar systems like: Cobra Dane, Pave Paws, BMEWS, Series 320 3D radar, OTH radars and dome antenna. The book has a catalog giving the detailed parameters for over 200 radars from around the world. The remaining chapters cover AEGIS SPY-1, Hybrid and MMIC circuits, ultra low sidelobe antennas (ULSA), mmw, radar cross section and Doppler weather radars. The material in the book is easy to access and as a result the text serves as a handy reference book.

This course is an updated version of the Radar Technology course given previously. Those who have taken the Radar Technology previously should find

it worthwhile taking this revised version. New material includes latest on solid state devices and transmitters including GaN, SiC, SiGe; Breakthroughs in Radar — \$10 T/R module, Digital Beam Forming (DBF), Packaging, Disruptive Technology, Metamaterials, radar on a chip, 32 element phased array on a chip, Memristors, Graphene. Also covered are radar height-range coverage diagram using the powerful SPAWAR's AREPS program. AREPS provides coverage for arbitrary propagation conditions (ducts [evaporation, surface, or elevated], subrefraction and superrefraction) and terrain conditions based on DTED map data. AREPS now accounts for surface roughness scattering and evaluates sea and land clutter backscatter versus range. Attendees will be told how to obtain AREPS FREE. Valued at over \$7,000. Also new is coverage of Anomalous Propagation and what to do about it. Finally also covered is the new Multiple-Input Multiple-Output (MIMO) explained in simple physical terms.

Updated course is framed around FREE book described above. Also given at free are supplementary notes consisting of copies of >800 vugraphs plus over 15 paper reprints by Dr. Brookner.

For the beginner, basics such as the radar equation, MTI (Moving Target Indicator), pulse doppler processing, antenna-scanning techniques, pulse compression, CFAR, RAC and SAW devices, dome antenna, CCDs, BBDs, SAW, SAW monolithic convolvers, microstrip antennas, ultra-low antenna sidelobes (<-40 dB), stacked beam and phased array systems, (1-D, 2-D, Limited Field of View [LFOV]),

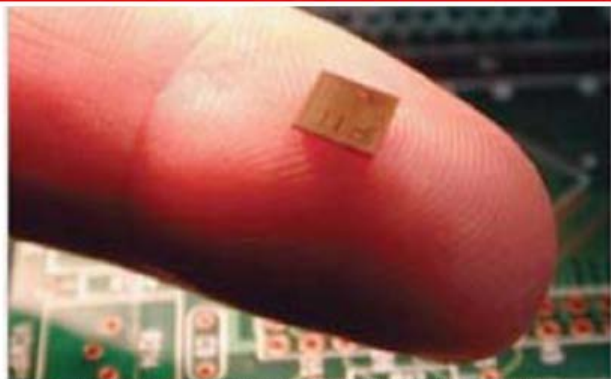
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Moving Target Detection (MTD) are all explained in simple terms. For both the novice and experienced covered are tracking, prediction and smoothing in simple terms (mystery taken out of GH, GHK and Kalman filters); the latest developments and future trend in solid state, tube and digital processing technologies; synthetic aperture radar (SAR); Displaced Phase Center Antenna (DPCA); Space-Time Adaptive Processing (STAP); digital beam forming (DBF); Adaptive-Adaptive Array Processing for jammer suppression with orders of magnitude reduction in computation; RECENT AMAZING RADAR BREAKTHROUGHS.

### Lecture 1, Oct. 24

**FUNDAMENTALS OF Radar: Part 1:** Very brief history of radar, major achievements since WWII: PHASED ARRAYS: Principles explained with COBRA DANE used as example. Near and Far Field Defined, Phased Steering, Time Delay Steering,

## SINGLE CHIP 77GHz RADAR



(G. KLARI, ET AL, "SINGLE CHIP MM RADAR", MICROWAVE J., 1-14-15;  
R. J. Evans et al., "Consumer Radar," *Int. Radar Conf.*, Adelaide, 9/2013, pp. 21-26)

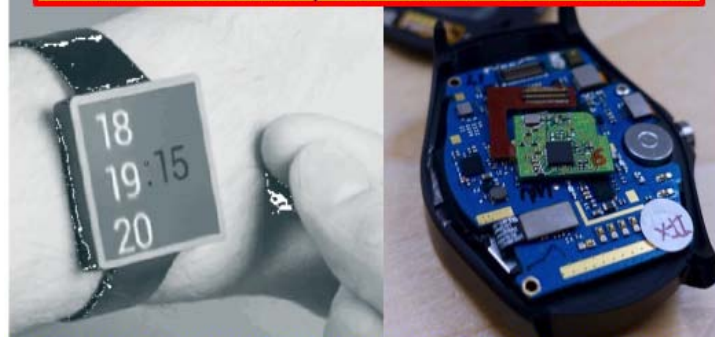
Subarraying, Array Weighting, Monopulse, Duplexing, Array Thinning, embedded element, COBRA DANE slide tour (6 stories building). Radar equation derived.

### Lecture 2, Oct. 31

**FUNDAMENTALS OF Radar: Part 2: FREQUENCY TRADEOFFS:** Search vs Track, Range and Doppler Ambiguities, Detection in Clutter. Blind Velocity

## GOOGLE RADAR IN SMART WRIST WATCH

**FITS ON PINKY TOE NAIL  
4 ANTENNAS; 0.05W DC POWER**



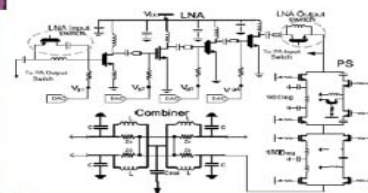
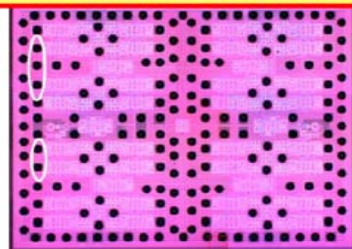
<http://spendergast.blogspot.com/2016/05/googles-project-soli-demos-mmwave-micro.html>  
<http://www.theverge.com/2016/5/20/11720876/google-soli-smart-watch-radar-atap-io-2016>

region, range eclipsing, Environmental Factors, Dependence of clutter model on grazing angle and size radar resolution cell discussed, Weibull clutter: Polarization Choice, Detection of Low Flying Low Cross-Section Targets, Antenna Pattern Lobing in Elevation due to multipath, Ground Multipath Elevation Angle Error Problem and ways to cope with it, e.g., use of an even difference pattern Off-Axis Monopulse, Complex Monopulse, Two Frequency Radar Systems: Marconi L- and S-band S631, Signaal/Thales (Holland), Flycatcher X and Ka System; Tube and Solid State OTH. Radars

### Lecture 3, Nov. 7

**FUNDAMENTALS of Radar: Part 3: PROPAGATION:** standard, superrefraction, subrefraction, sur-

## INTEL 32-ELEMENT SINGLE CHIP 60 GHz TX/RX PHASED ARRAY



### EXTREME MMIC

- Based on work with UCSD (we helped them a lot)
- Flip-chip packaging – CMOS from TSMC.
- Does not contain baseband circuitry for Gbps communications



face-based ducts, evaporation ducts. Determination of radar coverage using new AREPS program. ANTENNA SCANNING SYSTEMS: Fixed Beam System: Wake Measurement Radar; 2-D Radars, 3-D Radars: Stacked Beam: Marconi Martello, Smart-L, SMARTELLO, ARSR-4; 1-D Frequency Scanning: ITT Series 320; 1-D Phased Scanning: TPS-59, GE-592, RAT-31DL; Phased-Frequency Scanners: Raytheon Fire Finder and Plessey AR320; Limited and Hemispherical Scanning (Dome Antenna) related and explained in simple terms.

#### Lecture 4, Nov. 14

**FUNDAMENTALS of Radar: Part 4: ULTRA LOW ANTENNA SIDELOBES (40 dB down or more). MOVING TARGET INDICATORS (MTI):** Two-Pulse Cancellor, Pulse Doppler Processing; **MOVING TARGET DETECTOR (MTD):** Optimum Clutter Cancellor, STAP, AMTI, DPCA.

#### Lecture 5, Nov. 21

**SIGNAL PROCESSING: Part 1: What is PULSE COMPRESSION?** Matched Filters; Chirp Waveform

**NUMBER OF TRANSISTORS  
MADE IN 2014\*:  $2.5 \times 10^{20}$**

**USING VACUUM  
TUBES WOULD  
COVER EARTH  
SURFACE & BE  
53 FT HIGH\*\***



(\*IEEE SPECTRUM: <http://spectrum.ieee.org/computing/hardware/transistorproductionhasreachedastronomicalscale>)

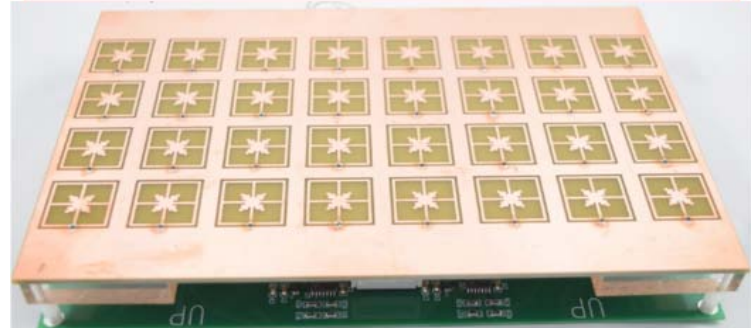
\*\*ASSUMED EACH TUBE OCCUPIED  $1 \times 1 \times 2 \text{ IN}^3$

Defined; ANALOG PROCESSING: Surface Acoustic Wave (SAW) Devices: Reflective Array Compressor (RAC), Delay Lines, Bandpass Filters, Oscillators, Resonators; IMCON Devices; Analog Programmable Monolithic SAW Convolver; BBD/CCD. What are they?

#### Lecture 6, Nov. 28

**SIGNAL PROCESSING: Part 2: DIGITAL PROCESSING:** Fast Fourier Transform (FFT); Butterfly, Pipeline and In-Place Computation explained in simple terms; Maximum Entropy Method (MEM)

#### PARC\* METAMATERIAL CAR ARRAY



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[HTTP://BLOGS.PARC.COM/2015/10/SELF-DRIVING-CARS-NEED-BETTER-DIGITAL-EYES-TO-DETECT-PEDESTRIANS/](http://blogs.parc.com/2015/10/self-driving-cars-need-better-digital-eyes-to-detect-pedestrians/)

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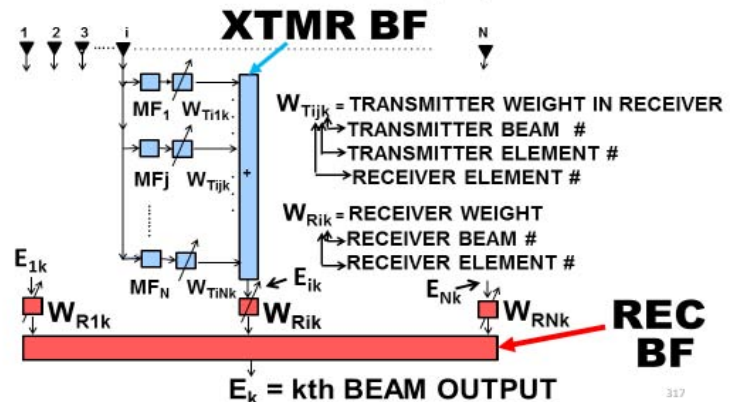
Spectral Estimate; State-of-the-art of A/Ds, FPGAs and Memory; Signal Processor Architectures: Pipeline FFT, Distributed, Systolic; Digital Beam Forming (DBF). Future Trends.

#### Lecture 7, Dec. 5

**SYNTHETIC APERTURE RADAR (SAR):** Strip and Spotlight SAR explained in simple terms. TUBES: Basics given of Magnetron, Cross Field

#### MIMO MONOSTATIC ARRAY

XTMR/REC BEAMFORMER (BF) IN RECEIVER



Amplifiers, Klystrons, Traveling Wave Tubes, Gyro Tubes.

**TREND TOWARD SOLID STATE PHASED-ARRAY TRANSMITTERS:** Discrete All Solid State PAVE PAWS and BMEWS radars; advantages over tube radars; MMIC (Monolithic Microwave Integrated Circuitry; integrated circuitry applied to microwaves components): THAAD, SPY-3, IRIDIUM, XBR, JLENS. Solid State 'Bottle' Transmitters: ASR -11/ DASR, ASR-23SS, ASDE-X. Extreme MMIC.

## Lecture 8, Dec. 12

### Breakthroughs and Trends in Phased-Arrays and Radars

Systems: 3, 4, 6 face "Aegis" systems developed by China, Japan, Australia, Netherlands, USA; Patriot

#### SS\* AIR TRAFFIC CONTROL RADARS

L-Band Solid State (SS) Xtrm ASR-23SS



S-Band Solid State Xtrm ASR-11 (DASR)



Upgrade of 65 Tube ARSR Radars to SS ~\$250M\*\*



\*SS=SOLID STATE  
\*\*J. WANG,  
E. BROOKNER,  
RAYTHEON US PATENT  
2009/0096662 A1

Photos Courtesy Raytheon

now has GaNAESA providing 360o coverage without having to rotate; S/X-band AMDR provides 30 times the sensitivity and number of tracks as SPY-1D(V). Low Cost Packaging: Raytheon funding development of low cost flat panel X-band array using COTS type printed circuit boards (PCBs); Lincoln-Lab./MA-COM developing low cost S-band flat panel array using PCBs, overlapped subarrays and a T/R switch instead of a circulator; Extreme MMIC: 4 T/R modules on single chip at X-band costing ~\$10 per T/R module ; full phased array on wafer at 110 GHz; on-chip built-in-self-test (BIST); Digital Beam Forming

(DBF): Israel, Thales and Australia AESAs have an A/D for every element channel; Raytheon developing mixer-less direct RF A/D having >400 MHz instantaneous bandwidth, reconfigurable between S and X-band; Lincoln Lab increases spurious free dynamic range of receiver plus A/D by 40 dB; Radio Astronomers looking at using arrays with DBF. Materials: GaN can now put 5X to 10X the power of GaAs in same footprint, 38% less costly, 100 million hr MTBF; SiGe for backend, GaN for front end of T/R module. Metamaterials: Material custom man made (not found in nature): electronically steered antenna at 20 and 30 GHz demonstrated (with goal of \$1K per antenna) remains to prove low cost and reliability); 2-20GHz stealthing by absorption simulated using <1 mm coating; target made invisible over 50% bandwidth at L-band; Focus 6X beyond diffraction limit at 0.38  $\mu\text{m}$ ; 40X diffraction limit,  $\lambda/80$ , at 375 MHz; In cell phones provides antennas 5X smaller ( $1/10\text{th } \lambda$ ) having 700 MHz-2.7 GHz bandwidth; Provides isolation between antennas having 2.5 cm separation equivalent to 1m separation; used for phased array WAIM; n-doped graphene has negative index of refraction, first such material found in nature. Very Low Cost Systems: Valeo Raytheon (now Valeo Radar) developed low cost, \$100s, car 25 GHz 7 beam phased array radar; about 2 million sold already, more than all the radars ever built up to a very few years ago; Commercial ultra low cost 77 GHz Roach radar on 72mm<sup>2</sup> chip, uses >8 bits 1 GS/s A/D and 16 element array; Low cost 240GHz 4.2x3.2x0.15 cm<sup>3</sup> 5 gm radar for bird inspired robots and crawler robots, Frequency scans 20x80 beam  $\pm 25^\circ$ . SAR/ISAR: Principal Components of matrix formed from prominent scatterers track history used to determine target unknown motion and thus compensate for it to provide focused ISAR image. Technology and Algorithms: Lincoln Lab increases spurious free dynamic range of receiver plus A/D by 40 dB; MEMS: reliability reaches 300 billion cycles without failure; Has potential to reduce the T/R module count in an array by a factor of 2 to 4; Provides microwave filters like 200 MHz wide tuneable from 8-12 GHz; MEMS Piezoelectric Material = piezoMEMS: Enables flying insect robots; Printed



Electronics: Low cost printing of RF and digital circuits using metal-insulator-metal (MIM) diodes, 2D MoS2 ink and 1.6 diodes GHz (goal 2.4 GHz) made with Si and NbSi2 particles; Electrical and Optical Signals on Same Chip: Electricity and light can be simultaneously transmitted over a silver nanowire combined with single layer 2D MoS2, could be a step towards transporting on computer chips digital information at the speed of light; COSMOS: DARPA revolutionary program: Allow integration of III-V, CMOS and opto-electronics on one chip without bonded wires leading to higher performance, lower power, smaller size, components; MIMO (Multiple Input Multiple Output): Where it makes sense; contrary to what is claimed MIMO array radars do not provide 1, 2 or 3 orders of magnitude better resolution and accuracy than conventional array radars; MIMO does not provide better barrage-noise-jammer, repeater-jammer or hot-clutter rejection than conventional array radars; should not be better for detecting low velocity targets in airborne STAP radar; Graphene and Carbon Nanotube (CNT): Potential for Terahertz transistor clock speeds, manufacture on CMOS demo'd, could allow Moore's law to march forward using present day manufacturing techniques; potential for non-volatile memory, flexible displays and camouflage clothing, self-cooling, IBM producing 200 mm wafers with RF devices; Electron spin: For memory; Atomic Memory: 12 iron atoms for 1 bit of memory; could provide hard drive with 100X density; Revolutionary 3-D Micromachining: integrated circuitry for microwave components, like 16 element Ka-band array with Butler beamformer on 13X2 cm2 chip; Superconductivity: We may still achieve superconductivity at room temperature; Superconductivity recently obtained for first time with iron compounds; DARPA UHPC (Ubiquitous High Performance Computing) Program): Goal: Reduce signal processing power consumption by factor of 75; Biodegradable Array of Transistors or LEDs: Imbedded for detecting cancer or low glucose; can then dispense chemotherapy or insulin; Quantum Radar: See stealth targets; New polarizations: OAMs, (Orbital Angular

Momentum) unlimited data rate over finite band using new polarizations??

### Lecture 9, Dec. 19

**TRACKING, PREDICTION AND SMOOTHING:** Simple Algebra and Physical explanation. Mystery taken out of  $\alpha\beta$  (GH) Filter; Errors of; Fading Memory; Benedict-Bordner; Example Designs; Stability; Tracking Initiation;  $\alpha\beta\gamma$  (GHK) Filter; Kalman Filter Explained in simple physical terms; Why Kalman Filter?; Relationship to GH and GHK Filters; Matrix Notation; Simple Derivation.

### Lecture 10, Jan. 9

**HOW TO LOOK LIKE A GENIUS IN DETECTION WITHOUT REALLY TRYING:** Simple procedure for determining detection using Meyer Plots, MATLAB, Excel and MATHCAD is presented. No detailed mathematics used, emphasis on physical understanding of target models (non-fluctuating, Marcum, Swerling, Weinstock, Chi-Square, Rayleigh, Lognormal, Rice and YGIAGAM) and performance results. Also covered are beam shape, CFAR, mismatch losses.

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|                         | Value |
|-------------------------|-------|
| Textbook .....          | \$159 |
| Reprints .....          | \$150 |
| Over 800 Vugraphs ..... | \$120 |

**Decision (Run/Cancel) Date for this Courses is  
Monday, October 17, 2016**

#### Payment received by October 12

|              |       |
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|--------------|-------|
| IEEE Members | \$340 |
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