Prof. R. E. Kalman, discoverer of the famous Kalman-Filter and many other fundamental principles in modern system theory, was the invited speaker at the banquet event of the 34th annual meeting of the Southeastern Symposium on System Theory (SSST), hosted this year by the UAH ECE Department and held at the Huntsville Marriott Hotel on March 18-19, 2002. The 34th SSST was dedicated to Prof. Kalman in recognition of: “...his unparalleled influence on the evolution of System Theory to the scientific discipline it is today.”

Prior to his talk, Dr. Kalman was introduced by his long-time friend and another pioneering researcher in modern control and system theory, Dr. R.W. Bass (Ph.D. Mathematics at age 25, Johns Hopkins University). Dr. Bass provided some interesting recollections of system theory research activities in the period 1955-1960 when Kalman began his rise to fame, after joining the staff of the Martin Company’s Research Institute for Advanced Study (RIAS) in Baltimore. Dr. Bass, acting as a talent scout for the world famous Princeton University Mathematics Professor Solomon Lefschetz, “discovered” Kalman and was instrumental in bringing him into the RIAS research group in 1957. The full text of Dr. Bass’s presentation is contained in a separate article in this issue of Real Time.

Dr. Kalman’s talk, entitled “Research: Then and Now; Some Straight-Talk About Randomness,” was broadly concerned with the concept of “randomness” and how the traditional textbook introduction of that concept is ineffective from the point-of-view of system theory. Never known as one who avoids rocking-the-boat, Dr. Kalman briefly summarized the thrust of his talk with the following provocative, pre-conference abstract of his talk: “Looking back on a 50-year commitment to research, the speaker will explain how this commitment became a dominant concern after the discovery of Kalman filtering and led, inevitably, to a deep examination of the basis for (and limitations inherent in) that invention. It is now known that modeling randomness in the real world by means of, or as a consequence of, probability theory is not only naive but unscientific; a fresh start must be made and is now well underway.”

Available space here does not allow an appropriate coverage of Dr. Kalman’s stimulating remarks on the concept of “randomness,” but the interested reader can find the technical details presented in several of his recently published scientific papers listed under Further Reading at the end of this article.

The Southeastern Symposium on System Theory (SSST) is an annual technical meeting of educators, graduate students, and professional researchers in the field of System Theory, who meet to present technical papers on advances and applications of system theory in traditional engineering areas such as: computer and information systems, communication systems, guidance/navigation and control systems, radar systems, power systems, etc., as well as non-traditional engineering areas such as economic systems, healthcare systems, environmental systems, educational systems, security systems, etc.

(Continued on page 2)

Dr. Robert W. Bass and Dr. Rudolf E. Kalman at the 34th SSST.

Press in book form and in which I have reviewed scores of published papers on the subject. But Kalman’s approach struck me as so stunningly original that as I said at the time, “I nearly fell out of my chair!”

I soon learned that Rudolf was an MIT-trained electrical engineer who after designing and building an adaptive control system at DuPont was now pursuing a doctorate at Columbia University.

On that occasion I gave Rudolf a copy of a paper which I had submitted to the following month’s Brooklyn Polytechnic Institute Symposium on Nonlinear Circuit Analysis in which I employed state-variable techniques that I had learned from Wiener, Hartman & Lewis at JHU and from their and Lefschetz’s former student Richard Bellman. In that paper I used Liapunov’s Second Method and the Gronwall-Bellman Lemma to define what I called then the “amount of [structural] stability” of a linear system but which in today’s terminology would be called a Stability Robustness Margin $p = p(F)$. Specifically, if $\Phi(t) = \exp(Ft)$ is the system’s state-transition matrix, then

$$||\Phi(t)|| \leq \gamma \exp(\lambda t), \quad \lambda > 0, \quad \gamma \geq 1,$$

where $\mu$ is the celebrated 1956 robustness criterion of Caltech’s famed Mu-Synthesis creator John Doyle, who was gracious enough some 35 years later to tell his graduate students in my presence that he had been “amazed” to learn that in 1956 I had published a lower bound to the reciprocal of his $\mu$ criterion for robust synthesis which had partially anticipated his own important discovery by some three decades.

Accordingly I flatter myself that it was from my 1956 paper that Kalman first appreciated the power of two of the three perspectives which he used in order to discover the by now ubiquitous Kalman Filter, namely the State Space approach and Liapunov’s Second Method. But regarding the third perspective, namely Wiener Filtering and related stochastic-process oriented results developed and fostered at MIT, I had known nothing and therefore would never have been able to conceive of, much less even conjecturally formulate, Kalman’s epochal discovery. But today, as you will soon hear, Kalman regards the stochasticity aspects as of less significance than mere uncertainty, whether probabilistic or deterministic.

(Continued on page 3)

Further Reading

Dr. Kalman’s critique of the conventional concept of “randomness,” and related technical details, are presented in several of his recent scientific papers. The interested reader is referred to the following:


Other researchers have addressed the same issue, but from different points of view. See, for instance:

Reminiscences: Bass and Kalman

(Continued from page 2)

Most systems engineers know that all modern aerospace and marine transportation systems, both civilian and military, depend upon the Kalman Filter as a mission-critical component of their guidance, navigation and control (GNC) systems. Likewise Kalman Filtering is essential for Fire Control in modern artillery. This state-variable estimation algorithm works online in real-time to estimate the unmeasured state-variables from the overall system's known dynamics together with feedback of those variables actually instrumented for real-time measurement. Accordingly the Kalman Filter algorithm's embodiment can be likened to a sort of synthetic super-sensor suite. In Kalman's own words, the dynamics-based Kalman Filter turned out to be more important than the purely stochastic Wiener Filter because "Newton is more important than Gauss!"

In 1955 Vice President George Trimmer of the Martin Co. (later Martin-Marietta and now Lockheed-Martin) sought to establish an industry-sponsored Research Institute for Advanced Studies (RIAS) in hopes of basic-research-derived technical breakthroughs that could assist our national defense in what was then called the Cold War for containment of expansive communism. Trimmer appointed Martin's accomplished electronics engineer, Welcome Bender, to recruit, staff and direct RIAS in a Baltimore residential suburb. Bender's first appointment was a recent JHU Ph.D. in physics, Lou Witten, an internationally recognized expert in gravitational physics whose son Edward Witten is today a renowned string theorist at the Institute for Advanced Study in Princeton. Noting that it was commonly acknowledged that Lefschetz did actually hire Kalman, I had to take a two-year leave of absence from the University of Pennsylvania in order to fulfill my ROTC obligation by active duty service in the Air Force starting in May 1957. When I returned to RIAS in May, 1959 I was in the audience and by asking positively-worded questions about their plans made it clear that it sounded good to me -- though at the time Lefschetz himself was understandably reluctant to leave Princeton for Baltimore.

When Lefschetz appeared to be unresponsive to any putative RIAS offer, they met me in an informal presentation of their plans regarding RIAS, in hopes of recruiting Lefschetz to direct an activity in nonlinear mechanics and related fields, such as control theory. I was in the audience and by asking positively-worded questions about their plans made it clear that it sounded good to me -- though at the time Lefschetz himself was understandably reluctant to leave Princeton for Baltimore.

Later I was able to persuade Lefschetz to accept an offer from RIAS to commute by train to Baltimore and direct an activity in nonlinear mechanics whose initial goal was to compete with Soviet activity in the same field. Years later I counted out that of the first 22 theoreticians to whom Lefschetz had made permanent or visiting offers at RIAS, about 11 of them had already been Lefschetz colleagues or proteges, such as Joseph LaSalle and Lamberto Cesari, but the other 11 of them (including Andre & Seibert, Kalman, Hale & Gambill, Pipino, Bucy, and Kushner) had been theorists whom I had first called to Lefschetz's attention directly or indirectly (e.g. by recommending Kalman who in turn recommended Bucy, etc.).

Kalman's nomination of Bucy was particularly inspired because Bucy soon proved that the well-known Ricatti Equation of the Calculus of Variations was in the case of finite-dimensional systems equivalent to the Wiener-Hopf Equation of stochastic filtering theory, and collaborated fruitfully with Kalman in generalizing all of Kalman's discrete-time results to the continuous-time case, where one now speaks of the Kalman-Bucy Filter. Also Kalman, Bucy and Englar produced at RIAS, under contract to NASA, the grandfather of all Automatic Synthesis Programs, the famous ASP-C program of 1965, which in FORTRAN could cope with dimensions exceeding \( n = 10^9 \). Today the Peacekeeper ICBM is known to employ an onboard real-time Kalman Filter of state-space dimension \( n \) exceeding \( n = 100^9 \). I well remember that when at Princeton in 1957 I first tried to tell Lefschetz how brilliantly original Kalman was, a world-famed and prize-winning European mathematician turned to me and said: "Tell me: WHY are you so interested in this little engineer?"

After I had worked at RIAS for less than a year, and just before Lefschetz did actually hire Kalman, I had to take a two-year leave of absence in order to fulfill my ROTC obligation by active duty service in the Air Force starting in May 1957. When I returned to RIAS in May, 1959 I became absorbed in my own efforts to find a closed-form solution for the nonlinear state-variable feedback control law of Time-Optimal or "bang-bang" control systems and therefore was not aware of what Rudolf Kalman had been working on.

College of Engineering's Highest Achievement Award

Janice Cicero Rock

Ms. Janice Rock is graduating with a Bachelor of Science in Engineering with a major in Electrical Engineering. She has maintained a perfect GPA at UAH. Janice is an Amateur Radio Operator who holds the highest amateur class license. She is an on-call member of ALERT, the Birmingham SKYWARN group. During the April 1998 Jefferson County tornado, Janice relayed many vital weather reports via amateur radio and also helped rescue efforts at the site, including saving victims from the rubble of demolished homes. She was awarded the ARRL (American Radio Relay League) Emergency Communications Commendation for her efforts during this event. Janice is a Volunteer Examiner for the FCC, and an avid amateur meteorologist.

She is a competitive figure skater who holds over 50 gold medals from regional events and now teaches figure skating. Janice is a former ice-dance partner of Olympian skater John Zimmerman who placed fifth in pair’s figure skating in the Winter Olympics in Salt Lake City. She enjoys snowboarding, white-water kayaking, rock climbing, hiking. Janice was an Assistant Race Marshall for the Mulberry Fork Canoe and Kayak Race in 1997. She held two Alabama Cups in white water slalom racing during 1996 and 1998.

Janice's Final Design Project (with two other students) was to design and build a yagi antenna system that will bounce VHF signals off the moon to extend "line-of-sight" communication to its greatest limits. Through her efforts as team leader, her design team received approximately $1,000 in donated equipment for their project from the Cushcraft Corp., NH. Only about 100 of these systems in the world. The now the only operational system of its type in the State of Alabama. She is a member of Phi Theta Kappa (Junior College honor society),Eta Kappa Nu (Electrical Engineering honor society), Tau Beta Pi (National Engineering honor society), and Phi Kappa Phi (Multi-discipline honor society). Upon graduation, Janice plans to work at AMCOM in research and development and return to UAH for her graduate degree.
I hope everyone had a good Spring semester and is ready for a refreshing Summer. You have probably noticed a lot of changes going on around the Engineering Building. Several new Pentium 4 computers have been purchased, and most all the labs in the Engineering Building have been or will be upgraded with the new systems.

In addition, new equipment such as scopes, power supplies, multimeters, and training boards are being purchased and several of the Electrical and Computer Engineering instructional labs will be upgraded over the summer. The Virtual Control (instructional) Laboratory is closer to being a reality. Ten Pentium III systems have been set up with remote access software in EB262 to provide access to the Virtual Laboratory systems in EB124, pictured below. According to Dr. Shitsesel the lab is in its final phase of preparation.

Virtual Controls Lab: The Development of the Virtual Control and Dynamic System Laboratory is funded by the NSF grant DUE-9952801. Principal investigator (PI) is Dr. Y. Shitsesel (ECE), Co-PIs are Dr. C. D. Johnson (ECE), Dr. R. Fredrick (MAE), and Mr. R. Middleton (MAE). Graduate student Sergei Pleckhanov (ECE) is working on laboratory manuals under the supervision of Dr. Shitsesel. Six laboratory units: Position Servomechanism (three units), Flexible joint Servomechanism, Magnetic Levitation Unit, and Linear Inverted Pendulum equipped with a corresponding software are already installed in the EB124. The lab units will be available for experiments soon. Please visit our Web Site, http://www.eb.uah.edu/~controls/index.htm

In the last issue of Real Time I made the comment "I have noticed a lot of activity around Engineering Building. In particular, I have noticed several students and professors working in the ECE labs..." This is about to grow exponentially if CubeSat (see page 1) gets the response expected.

Reminiscences: Bass and Kalman

(Continued from page 3)

One day I said to Kalman quite naively, "If you have n state variables then you need n sensors." "No, Bob, that's not true," replied Rudolf. "If a system satisfies my criterion of Observability, then you can optimally estimate all unmeasured state variables by using the ones that are measured together with the system's known dynamics. I have been shouting that from the rooftops for the past year! Haven't you been listening?"

Later I asked Rudolf how one could be sure that one actually "knew" the dynamics of the system being controlled. Quoting something else which he had learned at MIT and which I had never heard of, Rudolf replied, "In principle, that's easy! You just take the cross-correlation of the output with its command input and then in a suitable sense divide it by the input's auto-correlation in order to get the input-output transfer function!"

During the years just before and after Kalman accepted a professorship at Stanford in 1964 he published algebraic results pertaining to realization theory, or modeling of linear input-output systems, which laid the groundwork for a stunning discovery by his graduate student B. L. Ho. I am referring to Ho's doctoral dissertation's main result, published in 1966 as a joint paper with Kalman, which I regard as the most profound theorem pertaining to the Systems Identification (ID) problem. Firstly, if noise is negligible, then from input-output measurements one may compute the so-called Markov parameters, or coefficients of a Taylor-series expansion in the complex frequency domain of an empirical transfer function. Secondly, arrange the Markov parameters into an infinite Hankel matrix, each of whose elements is an l by m matrix in the case of l outputs and m inputs. Then the rank r of this matrix defines the minimal dimension of a state-space model of the system! Moreover, by elementary matrix algebra one may compute from the principal n x n sub-block of the Hankel matrix a triad of matrices ($F$, $G$, $H$) having respectively dimensions $n \times n$, $n \times m$, $l \times n$ and which are called the dynamical coefficient matrix, the input coupling matrix (or actuator kinematics matrix) and the output coupling matrix (or sensor kinematics matrix). Furthermore the pair ($F$, $H$) satisfies Kalman's criterion of Observability (which enables applicability of the Kalman Filter to estimate the l optimally all n state variables from the l inputs, n outputs) and the pair ($F$, $G$) satisfies Kalman's criterion of Controllability (which enables one to derive the optimal Kalman Regulator Law for state-variable feedback control). Furthermore, by Kalman's important Principle of Duality, results in asymptotic estimator theory may be converted into results in control theory, and conversely, by simple matrix transposition operations. By my own Algebraic Separation Theorem, one may design the control system as if all n state-variables were measured and available for feedback, then design a Kalman Filter to estimate them, and combine the two results into an over-all stable system whose 2n poles combine those of the ideal regulator and the optimal filter. Moreover it can be proved by Stochastic Optimization Theory, in what some term the Guidance/Navigation Separation Principle, that such a 2n-pole system is a genuinely optimal system of the so-called LQG type. Here L refers to the assumption of linearity employed in the Ho-Kalman Identification Lemma, while Q refers to the fact that the Kalman Regulator Law minimizes the integral over future time of a prespecified arbitrary quadratic form in the state-variables and control variables. Finally, the G refers to the fact that the Kalman Filter provides an unbiased minimal-variance estimation of the state-variables when the process disturbances and measurements noises are all Gaussian white-noise processes.

The only fly in the ointment of LQG theory is that the resultant "optimality" is very fragile if the actual disturbances and noises have covariance intensity matrices different from those assumed during the design. Here I and my collaborator Dean Zes have published a theory of Robust Tuning of a Kalman Filter in which we showed how to choose fictitious covariances that maximize my 1956 Robustness Margin $\rho$ to produce a system optimally insensitive to whatever the off-nominal noise may be. The dual of this enables us to engage in Robust Tuning of a Kalman Regulator by maximizing its closed-loop Robustness Margin $\rho = \lambda \gamma^2$. This can be understood as forcing the system to have the relatively fastest response time or largest $\lambda > 0$ possible while simultaneously constraining increases in its overshoot coefficient $\gamma > 1$, i.e. by selecting the "most negative" real parts of its closed-loop poles that are compatible with simultaneously minimizing the associated residues. In short, a "robustified" system behaves like a scalar system of transfer function $\gamma(s + \lambda)$ wherein $\rho = \lambda \gamma^2$ is maximized.

Another aspect of rendering a system insensitive to uncertainty is that of replacing the usual stochastic noises and disturbances by waveform-based disturbances modeled by a priori defined auxiliary linear systems whose states can be identified by a Kalman Filter and thereby provide synthetic disturbance feedforward capability. This Disturbance Accommodating Control (DAC) theory of C.D. Johnson is an effective way to accommodate random-like disturbances having a strong component of systematic or semi-deterministic time-behavior, and my collaborator Dan Hill and I have incorporated it in our "grandson-of-ASP-C" RhoSyn/DAC public domain MATLAB toolbox.

(Continued on page 6)
Success of the 34th SSST: A Result of Combined Efforts of Many

The success of the 34th Southeastern Symposium on System Theory, hosted by the UAH ECE Dept., was made possible by the combined efforts of many individuals and organizations who generously contributed their time, labor, and skills, as well as financial and logistical support. The members of the 34th SSST Organizing Committee and their areas of responsibility were: General Chairman – Dr. Reza Adhami; Technical Program Chairman – Dr. John Stensby; Planning, Coordination, Accommodations, and Publications – Dr. C. D. Johnson; Registration – Dr. Michael Oliver, Director of Continuing Education; Reception – Dr. Laurie Joiner; Publicity – Dr. Alex Poularikas; Donations – Dr. Reza Adhami and Dr. Ned Audel.

The widespread ranging, word-processing and graphics efforts associated with preparation of the SSST Proceedings volume, the Technical Program booklet, the Program for the Dinner Banquet and Speaker event, and numerous other documents were provided by ECE Technical Secretary, Mrs. Linda Grubbs, who also spent many hours running the Conference Registration Table, ably assisted by ECE secretaries Mrs. Jackie Siniard and Mrs. Linda Hooper (formerly “the” secretary of the ECE Dept., now retired). Each of the four meeting rooms, in which the conference Technical Sessions were held simultaneously, was equipped with UAH-provided equipment consisting of an overhead projector, an LCD projector, and a desktop PC to accommodate a variety of speaker presentation formats. The daunting effort required to set-up, check-out, and provide continuous operational support and security for that equipment, throughout the conference, was provided by Mr. Dennis Hite, ECE Technical Services and operational support and security for that equipment, throughout the conference, was provided by Mr. Dennis Hite, ECE Technical Services and his several assistants. Mr. Jason Winningham, Computer Systems Engineer, UAH ECE Dept., also provided valuable help in establishing the SSST website. Ashley Phillips, ECE student and webmaster for the ECE site, was diligent in keeping the SSST material updated on a timely basis. Ms. Michelle Buckelew of Allied Photocopy contributed greatly to support and reporting services.

The introduction and timely coordination of speakers at the 24 technical sessions was critical to the success of the 34th SSST. The volunteer Session Chairpersons who provided that valuable service were: Dr. Jeffrey Kulick, UAH; Dr. W. D. Blair, Georgia Tech; Dr. Torn Jammet, UAH; Dr. Dennis Irwin, Ohio University; Dr. Jim Zhu, Ohio University; Dr. Nagendra Singh, UAH; Dr. Laurie Joiner, UAH, Dr. Reza Adhami, UAH; Dr. Alex Poularikas, UAH; Dr. John Stensby, UAH; Dr. Jennifer English, UAH; Dr. Derald Morgan, UAH; Dr. Bassem Mahafza, Colsa Corp.; Dr. Richard Gordon, Ole Miss; Dr. Charles Corsetti, UAH; Dr. Earl Wells, UAH; Dr. John Gray, Naval Surface Warfare Center, Dr. Dan Hahs, Dynetics Inc.; Dr. Yuri Shtessel, UAH; Dr. Asad Davari, West Virginia University; Dr. Emil Jovanov, UAH, and Dr. Arlynn Wilson, Adtron Corp. Mr. William (Buddy) Bishop, UAH part-time faculty, provided valuable “stand-by” support for any emergency and/or “no-show” situations that might have arisen at the SSST; fortunately, there were none.

The synergistic efforts of all these persons enabled the 34th SSST to reach a new level of effectiveness and professionalism that will serve as the standard-for-comparison in the future.

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Outstanding Undergraduate in the Electrical Engineering Program

Joel Patrick Booth

Mr. Joel Patrick Booth is graduating with a Bachelor of Science in Engineering with a major in Electrical Engineering. His Senior Design Project was to design and build a yagi antenna system (page 3) that will bounce VHF signals off the moon to extend “line-of-sight” communications to its greatest limit. Only about 100 of these systems are in operation around the world. Now it is the only operational system of its type in the State of Alabama.

Joel is a determined individual. He is a recipient of the Dr. Wernher Von Braun Award and a 2-time recipient of the Radio Club of America Award.

Joel is an Amateur Radio Operator, a member of ALERT, the Birmingham SkyWARN group. Joel works with the group relaying vital information to the National Weather Service by either ground-level storm spotting or as a Net Control Operator. He is a volunteer examiner for the FCC. He is a member of Phi Theta Kappa,Eta Kappa Nu, Tau Beta Pi, and Phi Kappa Phi. Upon graduation, Joel will be working at the Propulsions and Structures Directorate on the Redstone Arsenal.

Joel enjoys snowboarding, white-water kayaking, rock climbing, and hiking.
Dr. Jamshid Nayyer joined the UAH ECE Department in February 2002 as a Professor of Electrical and Computer Engineering. Dr. Nayyer received his Ph. D. in Electronics Engineering from the Tokyo Institute of Technology in 1976 where he was involved in research works on optical multimode fibers.

During September 1986 to September 1987, he was a visiting scholar at the Tokyo Institute of Technology where he conducted original research works on high-speed optical switching. He joined the central research laboratories of Sumitomo Cement Co. in January 1990 where he designed numerous devices such as modulators, switches, branches, etc. and has published dozens of reviewed papers in internationally recognized journals. He holds one issued patent and a few in pending status.

Dr. Nayyer’s recent interests are in wide-band optical devices and optical communication networks. He enjoys and spends his spare time on jogging, table tennis and easy-listening music.

Reminiscences: Bass and Kalman

(Continued from page 4)

In 1960 Rudolf and I journeyed to the first IFAC in Moscow and one of my most-cherished memories is that of sitting next to Rudolf while Premier Kosygin was extolling the virtues of the 1958 Pontriagin Maximum Principle (whose main special case, namely that of the Adjoint System approach to Time-Optimal Control, I had anticipated in my 1956 paper).

In 1961 I gave a short-course at NASA Langley on “Modern Control Theory.” After returning I mentioned to Rudolf that I had proved that “if a system is Controllable according to your criterion of Controllability, then one may compute a control law which places the closed-loop poles in any prespecified stability-constellation.” Rudolf responded, “that’s very significant, Bob, because it establishes how fundamental my criterion of Controllability is!” Indeed, every contribution of Kalman to modern control & estimation theory has turned out to be truly fundamental.

In summary, Kalman’s seminal contributions include:

- The Kalman Filtering Theory
- The Linear Quadratic Optimal Control Theory
- The Control/Filter Duality Principle
- The Canonical Decomposition Theorem for Linear Input-Output Systems
- The Algebraic Realization Theory
- The Ho-Kalman Lemma re System ID via a Minimal Realization
- The discovery of a Liapunov Function for the Lur’e Problem
- Numerical analysis enabling an Automatic Synthesis Program (ASP-C)

For these and other contributions to systems theory Kalman has received many well-deserved prizes and medals. These include (as well as various European awards to mention):

- A Kyoto Prize in High Technology
- An IEEE Centennial Medal
- An IEEE Medal of Honor
- Membership in the US National Academy of Science
- Membership in the US National Academy of Engineering
- A Steele Prize of the American Mathematical Society
- An Oldenburger Medal of the ASME
- A Bellman Heritage Award of the ACC

Accordingly it is now my privilege to introduce to you the true Father of Modern Systems Theory, Professor Rudolf Kalman!
Mark Horton  
College of Engineering  
Outstanding Graduate Student In ECE

Mark A. Horton received both B.S.E. (1979) and M.S.E. (1999) degrees from the University of Alabama in Huntsville, ECE Department, where he is currently pursuing his Ph.D. under Dr. Reza Adhami. Mr. Horton has over 22 years experience in the development of real-time hardware-in-the-loop simulations that are used to evaluate the performance of U.S. Army air defense systems. He has spent the last year performing research in biometric based signal processing. His expertise includes radars, experimental and test development, signal processing, controls, random signals, and biometrics.

2000 - Present  U.S. Army AMCOM, Redstone Arsenal, Alabama  
DB94, Electronics Engineer, Man-in-the-Job Experimental Developer  
- Performed doctoral research in biometric based personal identification system signal processing culminating in two technical papers, passing of Ph.D. qualifying exams and acceptance of Ph.D. dissertation proposal.

DB93, Electronics Engineer  
- Led the design, development, and utilization of five world-class state-of-the-art high-fidelity hardware-in-the-loop (HWIL) performance evaluation simulation test-beds for the PATRIOT air defense system.
- Led the design, development, and utilization of two exceptionally complex high-fidelity HWIL electromagnetic interference effects test-beds for the HAWK and PATRIOT air defense systems.
- Designed and developed a state-of-the-art research tool for rapid test and development of improved HAWK missile track and guidance algorithms.

Bachelors of Science in Engineering, Electrical Engineering Option


Masters of Science in Engineering

Masters With Thesis (field)

Joseph Booth (Electrical); Thesis Advisor: Dr. J. Kulick

Chakravarthi Deverapalli (Electrical); Thesis Advisor: Dr. L. Joiner

Narendrakumer Patel (Electrical); Thesis Advisor: Dr. L. Joiner

David Sparks (Electrical); Thesis Advisor: Dr. Gregory Nordin

Steven Douglas Vanstone (Electrical); Thesis Advisor: Dr. Gregory Nordin

Koon-Kim Jeremy Wong (Electrical); Thesis Advisor: Dr. B. Peters

Christopher L. Zoller (Electrical); Thesis Advisor: Dr. L. Joiner

Non-Thesis Masters (field)

Coleman D. Bagwell (Electrical), Alex Boydstun (Electrical), John G. Brooks (Electrical), Eric T. Broyles (Electrical), Kevin Chan (Electrical), Chia Chi Chiang (Electrical), Kenneth Collier, Jr. (Electrical), Daniel T. Corley (Electrical), Craig A. Farlow (Electrical), James S. Jackson (Electrical), Peter S. Kerr (Electrical), Young-Ju Lee (Computer), Lixia Li (Computer) Marcus Oni (Electrical), Zenn Pan (Computer), Alexey Petrenko (Computer), Nazih Rahmanian (Electrical), Jeffrey P. Rice (Electrical), John W. Sadduth, Jr. (Electrical)

ECE Dept., UAH  7  Real Time
Fredric H. Clark

Dr. Fredric H. Clark received the College of Engineering Distinguished Engineer Alumni Award for his outstanding contributions in Electrical Engineering.

Dr. Clark earned his Bachelor of Science degree in Electrical Engineering from the University of Arkansas in 1967, and both his Master of Science in Engineering degree in 1969 and Doctor of Philosophy degree in 1980 from the University of Alabama in Huntsville, Electrical Engineering Department.

Dr. Clark is an owner, co-founder and President of CAS, Inc., a company that has specialized in weapon systems analysis and system solutions since its founding in 1979. Dr. Clark has over 30 years experience in management, research and development of complex systems. He has managed and directed operations at CAS as it has grown from it initial two founders to over 700 employees.

Dr. Clark’s experience has spanned the spectrum of aerospace systems, missile systems, radar systems, weapons systems effectiveness analyses, system countermeasures and counter-countermeasures, C3I systems, and land combat systems. Many of the developments simulated by Dr. Clark are utilized on Army air defense, missile defense, and aircraft systems. Additionally, for the past 20 years, Dr. Clark has been actively working with the US Allied Nations on the performance and improvements of their defense systems.

Prior to the starting of CAS, Inc., Dr. Clark worked at the IBM Corporation Federal Systems Division where he designed a Laser Guided Bombing System and digital navigation/bombing system for the B-52. While at IBM he also conducted analyses on the Apollo Moon Mission, the Skylab Program and initial designs of the Space Shuttle.

Eric R. Grigorian

Mr. Eric R. Grigorian received the College of Engineering Distinguished Young Engineer Alumni Award for his outstanding contributions in Electrical Engineering.

Mr. Grigorian earned both his Bachelor of Science in Engineering degree in 1983 and his Master of Science in Engineering degree in 1987 from the University of Alabama in Huntsville, Electrical Engineering Department. He has continued his education by taking additional postgraduate courses such as digital communications, digital signal processing, digital image processing, neural networks, as well as others. He is also a registered Professional Engineer with the State of Alabama, and is President of the IEEE Huntsville Section.

Mr. Grigorian has over 17 years experience in defense and commercial systems integration and deployment. He recently joined Z/I Imaging as Director of Computational Hardware Center of Competence. Previously, he was COO and Vice President of Product Development for Q-PC, Inc. and Vice President of Commercial Markets for Applied Data Trends, Inc. He worked in multiple Manager-Engineering roles for Intergraph’s Federal Systems Division, being responsible for design and development of programs such as rugged workstations for shipboard automation (Smartship), and Manual Air Defense Operations Center (MADOC), which was installed at multiple sites within Saudi Arabia.

Mr. Grigorian was lead engineer for the development and commercialization of a Real Time Video Scan Rate Converter. He also was Lead Hardware Engineer for several PATRIOT hardware and communications tasks. As part of his development activities, Mr. Grigorian designed and developed a PC based expansion card that allowed interface to HAWK and PATRIOT tactical data links.

Robert E. Skelton

Dr. Robert E. Skelton received the College of Engineering Distinguished Engineer Alumni Award for his outstanding contributions in Electrical Engineering.

Dr. Skelton earned the Bachelor of Science degree in Electrical Engineering in 1963 from Clemson University, the Master of Science in Engineering degree in 1969 from the University of Alabama in Huntsville, Electrical Engineering Department, and the Doctor of Philosophy in Mechanics and Structures in 1976 from the University of California in Los Angeles.

Dr. Skelton is currently a Professor at the University of California in San Diego, where he is Director of the Structural Systems and Control Laboratory and Director of the Aerospace Engineering Program. Prior to joining the faculty of UCSD, he was a Professor in Purdue University’s School of Aeronautics and Astronautics for 21 years, where he was Director of the Purdue Structural Systems and Control Laboratory. He is an internationally known researcher and educator, and has published 3 books and over a hundred journal papers on control.

Dr. Skelton began his career working on programs at the Marshall Space Flight Center, employed first with the Lockheed Missiles and Space Company and then the Sperry Rand Corporation, designing control systems for spacecraft. He received the SKYLAB Achievement Award from NASA in 1974. His pointing control design for the Apollo Telescope Mount paved the way for the Theory of Covariance Control, which he developed.

Dr. Skelton served on the National Research Council’s Aeronautics and Engineering Board. He serves on the External Independent Readiness Review Team for the Hubble Space Telescope. Dr. Skelton is a fellow of IEEE and AIAA. He is also an Associate Editor of three journals: the Journal of Mathematical Modeling of Systems, the Journal of Mathematical Problems in Engineering, and the Journal of Systems and Control. In 1991 he received the Alexander von Humboldt Foundation’s “Senior US Scientist Award.” In 1999 the American Society of Civil Engineers awarded him the “Norman Prize” for his contributions to the subject of Structural Control, a new area in which he is a pioneering researcher.
Alumni of Achievement

In 2001, the UAH marked fifty years of teaching in a year-long celebration called “Fifty Years of Class.” The UAH Alumni Association embarked on a project to recognize fifty graduates who exemplify UAH’s high standards and who personify the university’s first half century of progress. Winners were chosen to represent alumni from each of the five colleges who graduated at least ten years ago.

The following three ECE alumni were among the fifty UAH alumni recognized at the Alumni of Achievement Day celebration on February 4, 2002.


James H. Crocker — M.S., Electrical Engineering, 1975. Program Director, Next Generation Space Telescope Program, Ball Aerospace & Technologies Corporation

Kelly V. Grider, Ph.D. — M.S., Engineering, 1965; Ph.D., electrical Engineering, 1972. Engineering consultant, defense contractors and government projects

ECE Students Participate in 34th SSST

The Technical Program of the 34th SSST contained a number of papers authored, or co-authored, by ECE students. The students, and titles of their papers, are

Robert Adams

Ashkan Ashrafi

Coleman D. Bagwell

Vidhyacharan Bhaskar

Daniel Corley

Paul Cox

Aye man Ghobriel

Outstanding Undergraduate Student Computer Engineering Program

Toby Wayne Rimes
Mr. Toby Wayne Rimes graduated in Fall 2001 with a Bachelor of Science in Engineering with a major in Computer Engineering. He is a recipient of a 4 year Scholar Athlete on the UAH Men's Soccer Team. Toby is employed by Mentor Graphics in Huntsville, AL where he is a member of the Software Development team. His current assignment is developing a software for printed circuit board design.

Outstanding Undergraduate Student Optical Engineering Program

Todd Bohanan
Mr. Todd Bohanan graduated in Fall 2001 with a Bachelor of Science in Engineering with a major in Optical Engineering. In his senior thesis, "Pebble Bed Reactor for Powering Mobile Solid State Lasers", he addressed in part the use of nuclear reactors to power weapons lasers. Learning was Mr. Bohanan’s top priority. His advisor indicated that Todd often worked all night and then attended his class the next morning. Mr. Bohanan is an employee of the TVA Brown's Ferry Nuclear Plant.
**Publications, Presentations and Awards**

**ELECTROMAGNETICS**

**Fat Duen Ho, Professor**

**Journal Article**


**Conference Papers**


Todd MacLeod and Fat Duen Ho, “Simulation Model of a Ferroelectric Field Effect Transistor,” Accepted for presentation, *14th International Symposium on Integrated Ferroelectrics*, May 27-June 1, 2002, Japan.

**CONTROL**

**Yuri Shtessel, Associate Professor**

**Journal Articles**


Publications, Presentations and Awards

OPTICS

David Pollock, Assoc. Research Professor

Conference

Co-Chair Session I, “Traceability of Absolute Radiometry in Remote Sensing to SI Units with Steven Brown of the National Institute of Standards and Technology,” Conference on Characterization and Radiometric Calibration for Remote Sensing being held at Utah State University April 29 - May 2, 2002. [This is the third year for The University of Alabama in Huntsville to co-sponsor this conference.]

SIGNAL PROCESSING / COMMUNICATIONS

Reza Adhami, Professor and Chair

Conference Papers


Laurie Joiner, Assistant Professor

Conference Papers


SOLID STATE

Timothy Boykin, Associate Professor

Journal Articles


Book Chapter

[Although copyright date is 2000 the book itself did not appear until Late Spring 2001.]


Presentations


Dashen Shen, Professor

Journal Article

We celebrated the graduation of the third group of Master's students from our new ADTRAN Technical Development Program (TDP) in Electrical and Computer Engineering on May 24, 2002. Seven students graduated from TDP in Spring/Summer 2002. This was not simply a worthy achievement for these individual students, but it is a milestone for a unique partnership between UAH and ADTRAN, and a tribute to a new kind of alliance between academia and industry.

The TDP is a two-year program that integrates engineering design work experience with university graduate study. TDP participants are full time employees at ADTRAN while active in the program. Participants receive paid, 50% released time from work during academic terms when taking nine semester hours. Both internal and external candidates may apply to the program (e.g., current employees, new graduates, and experienced non-employees). TDP participants are selected using the normal evaluation and selection process utilized by ADTRAN.

Coleman D. (Chip) Bagwell received his B.S. degree in Computer Engineering from Mississippi State University in May 2000. Chip began working for ADTRAN in January 1998 as participant in the Mississippi State University Cooperative Education program. He became a full-time employee and TDP participant in May 2000 after the completion of his B.S. degree. Chip received his M.S.E. degree in Electrical Engineering in May 2002.

Alex Kim Boydstun received his B.S. degree from The University of Alabama in Huntsville in June 1992. Alex became a full-time employee and TDP participant with ADTRAN in August 2000. Alex received his M.S.E. degree in Electrical Engineering in December 2001.

John G. Brooks received his B.S. degree from the University of Alabama in December 1999. John began working for ADTRAN in March 2000, when he became a full-time TDP participant. John received his M.S.E. degree in Electrical Engineering in May 2002.

Kenneth Lee Collier, Jr. received his B.S. degree from the University of Alabama in Huntsville in December 1999. Kenneth began working for ADTRAN in January 2000, when he became a full-time TDP participant. Kenneth received his M.S.E. degree in Electrical Engineering in May 2002.

Daniel Corley received his B.S. degree from the University of Missouri in May 1998. Daniel became a full-time employee with ADTRAN in June 1998, and a TDP participant in August 2000. Daniel received his M.S.E. degree in Electrical Engineering in May 2002.

James Scott Jackson received his B.S. degree from Clemson University in May 2000. James became a full-time employee and TDP participant with ADTRAN in June 2000. James received his M.S.E. degree in Electrical Engineering in May 2002.

Peter Kerr received his B.S. degree from the University of Alabama in Huntsville in May 2000. Peter became a full-time employee and TDP participant with ADTRAN in August 2000. Peter received his M.S.E. degree in Electrical Engineering in May 2002.

Marcus Oni received his B.S. degree from Auburn University in August 1999. Marcus became a full-time employee with ADTRAN in September 1999, and a TDP participant in August 2000. Marcus received his M.S.E. degree in Electrical Engineering in May 2002.

Leif Sandstrom received his B.S. degree from Tennessee Technical University in May 2000. Leif became a full-time employee and TDP participant with ADTRAN in August 2000. On completion of a Thesis, Leif will be receiving his M.S.E. degree in Electrical Engineering in December 2002.

Congratulations ADTRAN Grads!

We want to hear from you!

The ECE Department looks forward to hearing your views and your success stories. Contact us to share your news and comments about your career and interests. Your story should be sent to realtime@ece.uah.edu