

Combining Research and Education through COMSARE

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Abstract

Activities that combine research and education are vital to producing highly skilled, critical thinking engineers. The Center of Microwave/Satellite and Radio-Frequency Engineering (COMSARE) at Morgan State University was founded to facilitate such activities. Under the leadership of Dr. Carl White, the center provides specialized training modules and research projects to its members. The training modules are collaboratively developed and supported by industrial partners. The research projects are designed to be consistent with the mission of the center and the university. Although the described training modules are specific to the microwave technology curriculum at Morgan, similar modules may be developed and integrated within an ABET approved curriculum.

This paper will describe the evolution and development of COMSARE's specialized training and research, the organizational structure of the center, the development of partnerships, its recruitment process and current statistics, and the future of engineering training and management.

I. Introduction

The information revolution has created an intensely competitive global marketplace that requires an ethnically diverse workforce. The members of this workforce must possess both technical and critical thinking skills able to embrace the rapid pace of technological change. Providing this qualified talent is a challenge facing many engineering schools across the nation. Candidates of ABET accredited universities are instilled with the required technological literacy; however, their critical thinking skills are typically obtained through years of on-the-job training or participation in research-based graduate study. Today's technical employer demands candidates that have these skills well in hand for quick industry assimilation and productivity.

To meet the demands, engineering schools, with the guidance of ABET, are revamping their undergraduate curriculum to include activities that stimulate and develop critical thinking skills. One such activity is the combining of research and education in the engineering curriculum. The Center of Microwave/Satellite and Radio-Frequency Engineering (COMSARE) at the School of Engineering of Morgan State University was founded to facilitate such activity. Since its inception, the director, along with COMSARE associates, partners and affiliates, have developed specialized training modules and research projects that produce highly skilled, critical thinking engineers.

This paper will describe the evolution and development of COMSARE's specialized training and research. It will begin with a brief description of COMSARE, its mission and organizational structure, of the development of partnerships, and of its recruitment and current statistics. General information on COMSARE's training modules and research projects will be given. Specific details cannot be given at this time due to the proprietary issues. Finally, this paper will conclude with a discussion on the future of engineering training and management.

II. COMSARE

The Center of Microwave/Satellite and Radio-Frequency Engineering (COMSARE) was founded at the School of Engineering of Morgan State University under the leadership of Dr. Carl White with initial support from ECSEL (Engineering Coalition of Schools for Excellence in Education and Leadership sponsored by NSF). Initially, the program provided design projects for senior engineering candidates. Currently, its mission is to establish and maintain a first-class modeling service which offers an enhance education to all engineering students while focusing primarily on increasing the number of minorities with skills in areas of device characterization, CAD software development, and device, circuit, and system modeling.

The internal organization structure of COMSARE consists of the director, three levels of associates, and assistants as depicted in the hierarchical diagram in Figure 1. Project Management Associates consists of Doctor of Engineering (D.Eng.) candidates who responsibilities include the overall management of research projects, assistance in project solicitation and proposal writing. Research and Development Associates are comprised of Master of Engineering (M.Eng.) and advanced undergraduate candidates. Their responsibilities include the assistance in the research and development of new technology. Their projects lead to the fulfillment of the M.Eng. and B.S.E.E. project requirement. Undergraduate and new technology candidates comprise the Engineering Associates level. They are responsible for completing the specialized training that will be discussed later. Engineering Assistants are those candidates that seek membership into COMSARE. They are required to pass an entrance examination administered by COMSARE associates.



Figure 1. COMSARE hierarchical structure.

Important to the success of COMSARE is the establishment of partnerships with government and industrial agencies. For more than a decade, COMSARE has worked closely with many of the leading microwave technology companies. Listed below are the primary industrial partners:

- Hewlett Packard/Agilent Technologies
- Hughes Electronics Corporation/The Boeing Company
- Northrop Grumman
- Johns Hopkins Applied Physics Laboratory

Together, these agencies have provided well over \$2 Million in financial support and equipment/software donations. Funds have been directed toward the purchase of equipment, and the payment of associates' tuition, fees and stipends. Following are the key factors that have contributed to the successful establishment of these relationships:

- performing immediate-impact and traditional research and development initiatives,
- providing cost-effective contractual services,
- providing expeditious technology transfer, and
- sharing highly-skilled technical talent

III. COMSARE Recruitment and Current Statistics

Recruitment and retention is key to the continued growth of COMSARE. Prospective associates and assistants are recruited via four different methods. The first method is the primary means of entrance for prospective undergraduate associates. Students participating in a pre-freshmen summer bridge program are introduced to the COMSARE. Upon successful completion of the program, and with a letter of expressed interest, students are recommended for admission. The second means of undergraduate admission is through EEGR215 Materials and Devices. Students who enroll in this course and show advanced proficiency in the course material are invited to membership by either the graduate teaching assistant or by Dr. White. The last means of undergraduate entrance is by recommendation from senior level associates.

Graduate students conducting research under the guidance of the director receive automatic admission into COMSARE. These students are continuing COMSARE undergraduates who have successfully completing the B.S. degree and seek graduate study, or they are recruited via MSU/COMSARE participation in career and college fairs.

Currently, COMSARE's has a total of forty (40) associates and assistants- seven (7) PM Associates, three (3) R&D Associates, ten (10) Engineering Associates, and ten (10) Engineering Assistants. Since its inception, COMSARE has produced a total of 150 highly skilled engineers, who are making productive contributions to their affiliate organizations.

IV. COMSARE Training

As stated previously, integration of specialized training and research within the curriculum is essential to producing highly skilled, critical thinking engineers. This section will give a general description of COMSARE's specialized training modules and research projects.

Each associate is required to participate in specialized training modules for the development of skills in a desired area of interest to the center and a sponsoring agent. The following will describe the training schedule and sample module designed for the pre-freshman entrant. Training modules for other entrants will differ depending on the entrant's knowledge base. The prospective pre-freshmen entrant's first year curriculum must include the following coursework:

- Calculus I & II
- Physics I & II
- English 101 & 102 &
- Chemistry

In addition to the curriculum, the prospective entrant must complete 15hrs/wk (min) of controlled study hall, must complete 8hrs/wk of technical training, and will participate in 40hrs/wk of summer research. The controlled study hall is managed by an R&D Associate and administered by EAs. Technical training consists of an introduction to computer basics, including computer manufacturing, software installation, and system debugging, an introduction to circuit theory, fundamental and advanced C programming, and an introduction to CAD (Agilent ADS). During the second semester, candidates are exposed to two-port theory, and basic semiconductor device applications. Over the summer, first year candidates are encouraged to participate in an MSU Summer Research Program. Research topics are supplied and guided by COMSARE senior associates. Typical research projects range from system optimization via parameter variation to application-specific circuit design using CAD developed skills. Under special arrangements, an Engineering Assistant may be placed in a summer internship position with a corporate sponsor. Upon completion of the first year training, prospective candidates are given oral examinations before a committee of COMSARE senior associates. Successful completion is determined by a unanimous vote of the committee. The candidate is promoted to the next level of association.

Currently, second, third, and fourth year training modules are specially designed based on the interests of the candidate, consistent with COMSARE's mission and objectives. These modules include topics in advanced materials and device applications, device characterization and instrumentation, linear and non-linear modeling, and microwave circuit theory and design. Computer programming is central to each of these modules. Engineering Associates in their second and third year are assisted in securing summer internship positions with our sponsors. During the internship period, the director communicates regularly with the hiring manager to insure that the associate receives meaningful work and proper exposure to the sponsor's organizations.

V. Future issues in engineering training and associate management

With the expected growth of COMSARE, both in its membership and in its corporate affiliations, a problem will exist in providing the proper management of student's academic and professional careers, while maintaining and improving the quality of education and training, and providing worthwhile research and work experiences. To deal with this issue, COMSARE has developed a new concept in academic and career management. This concept is based upon the establishment of a separate organization. This organization would create services to provide continuous expert coaching to enhance students' academic and professional careers and serve as client's agent/proxy. The Agency interacts with clients, the university, affiliate labs, and industry to assure:

- Total Academic Immersion,
- High End Supplemental Training for Engineers,

Total Academic Immersion (TAI) provides an environment for scholastic excellence by allowing students to focus exclusively on the demands and rigors of SME curricula. This is achieved by eliminating nuisances, distractions, and other potential barriers to success. In addition TAI delivers services and experiences to assure optimal academic performance and achievement.

High End Supplemental Training for Engineers provides periodic, high-end technical training to engineers on a life long basis, in order to maintain technical competency and currency, to meet the evolving needs of industry and to facilitate professional mobility (i.e., horizontal and vertical/multidiscipline). The flexibility in the training fosters continuous curriculum improvement.

Biographical Information

CARL WHITE

Carl White is Associate Professor of Electrical Engineering at Morgan State University. He received his B.S.E.E. in 1981 and M.S.E.E. in 1983 from Howard University. In 1988, he received his Ph.D. in Engineering from Cornell University. He is the Local Principal Investigator at Morgan for the ECSEL Coalition (Engineering Coalition of Schools for Excellence in Education and Leadership) and the Principal Investigator for the PACE Program. It is his concept to develop the undergraduate student leadership skills through the development and coordination of pre-college and college programs.

NATHAN L. RICHARDSON

Nathan L. Richardson is currently a doctoral candidate in the School of Engineering at Morgan State University. He received his B.S.E.E. in 1990 from Morgan State University and his M.S.E.E. in 1992 from the State University of New York at Binghamton. Mr. Richardson's research interests are in the areas of device characterization and modeling and microwave circuit design. Mr. Richardson is a student member of ASEE.