Proceedings of the Second Joint EMBS/BMES Conference
Houston, TX, USA • October 23-26, 2002

# LEARNING MEDICAL IMAGING IN CLASSROOM, VIRTUAL CLASSROOM AND LABORATORY CLASSROOM

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***Abstract:*** Exciting medical imaging technologies widely applicable to both clinical and basic science research have emerged over the last two decades and are crucially important to the biomedical engineering field. For undergraduate students, however, the "classroom-only" teaching style suffers from many limitations that make it difficult for students to gain a complete understanding of a particular system. In this university, we modified our existing medical imaging curriculum by associating a series of courses with research and clinical laboratories and formed an inherent medical imaging teaching program. We see that this program promotes students' interest to the subjects they are learning and enhances their understanding to medical imaging systems and applications.

**Keywords:** medical imaging curriculum, image processing, virtual laboratory, imaging simulation.

## I. INTRODUCTION

Biomedical engineering has been emerging as a multi-disciplinary engineering area in recent years. As a key component in this field, medical imaging, combining physics, mathematics, electrical engineering and computer engineering, provides students with a broad view of information technologies applied to biology and medicine. The curriculum for medical imaging education usually involves tremendous amount of prerequisite background knowledge and medical imaging systems are all different from each other. Typical medical imaging systems include radiographic imaging systems (x-ray, computed tomography (CT)), magnetic resonance imaging (MRI), ultrasound imaging, positron emission tomography (PET) and other nuclear medical imaging systems. Furthermore, ongoing advances in novel imaging techniques should be consistently and steadily integrated into the medical-imaging curriculum. It is nearly impossible, however, for textbooks to remain steadily up-to-date with respect to these novel, continually evolving technologies. Image processing techniques developed for research purposes are typically of interest primarily to the software engineering industry. In fact, however, these techniques are an inherent part of imaging systems. Allowing students to become involved in research projects gives them the opportunity to practice the knowledge they have just learned and to apply it to actual problems resembling those they may face in the future.

## II. METHODOLOGY

Based on above discussion, we have set up a three-step teaching mechanism for medical imaging curriculum for biomedical engineering students.

1) Classroom teaching: This is the traditional way to give students lectures that regard physics principles, mathematical derivations, system descriptions and textbook materials. Homework and tests are related to these instructions.
2) Virtual classroom teaching: Advanced web sites of medical imaging have been well developed (e.g., http://vision.beckman.uiuc.edu, http://www.cis.rit.edu, etc.). We direct students to read and use these web sites (if the program is executable). Students are also given projects to simulate learned medical imaging systems, such as CT. They compare their simulations to the results obtained from web sites to perceive any difference in these comparisons. We have also established our own simulation web site that is accessible through the Internet.
3) Laboratory classroom teaching: We set up a multi-department and multi-laboratory teaching schedule for students' visits to medical imaging systems that are on-site in actual laboratory settings. Students can absorb new ideas much faster when they are exposed to the real world than by learning from textbooks, especially in those subjects involving items of equipment [1,2]. We also try to attract students to our funded medical imaging research projects.

## III. CONCLUSION

This three-step teaching program has brought a broad view for students in their knowledge acquiring. Students learn in-depth medical imaging technologies from textbooks as well as from clinical and experimental research laboratories. As a result of this program, students will obtain a solid understanding of the basic principles of commonly used medical imaging systems and the ability to work directly on particular medical imaging systems. This program, when combined with courses in medical informatics, bio-signal processing, and medical intelligent systems, comprises the basic curriculum for students electing the biomedical information technology option.

## ACKNOWLEDGMENTS

This study was supported by the National Science Foundation (DUE-0127290).

## REFERENCES

[1]. Hooper RJL, O'Connor J, Cheesmar R. "Clinical case-based multimedia tutorials as a solution to some problems facing medical education," *Clinica Chimica Acta*, 270:1:65-74, 1998.

[2]. Schmidt A, Brück R, Hahn K, Labeque A, Popovic G, Ohler M, Riedel H, Rizvi N, Stange T. "TRANSTEC - A new tool for online educational multimedia training on innovative high aspect ratio microtechnologies," *Microsystem Technologies*, 6:109-112, 2000.