The collaborative research between Tulane’s Department of Biomedical Engineering and the LSU EYE Center has had one 5-year internal grant funded by the National Eye Institute, beginning July 2002. The grant, entitled “SOP: Optical Retinal and Foveal Imaging in the Optic Nerve Head”, follows a 4-year collaborative grant between the Principal Investigator, Claire Burgosme at the LSU EYE Center, and Professor Richard T. Hart as PI of the Tulane subaward. In the second year, Professor J-K Ghadiali joins Professor Hart on the Tulane portion of the studies. This second subaward, including indirect costs, totals $576,927 for the five years.

Professor Glenn A. Litvak has been awarded the only school-wide teaching recognition award to be students: the John Stilbs Award for Outstanding Undergraduate Professor for the University, 2001-2002. This is the third time (and second year in a row) that this award has gone to a BMEN faculty member.

Professor Eric A. Namazi’s NIH RO1 proposal entitled “Intracranial Pressure, Medullary Damage to the Optic Nerve Head” has been awarded funding for three years, beginning July 2002 by the NEI (National Eye Institute). The proposed aim is to use basic neuroscience approaches to investigate the mechanical environment of the supporting tissue for nerve fibers in the optic nerve head. The award amount for the three years, including indirect costs, totals $457,675.


BMEN STUDENT ACHIEVEMENTS AND RECOGNITION

The Southeast Affiliate Research Committee of the American Heart Association has awarded Russell Auger a two-year grant for his proposal “Mesenchymal Stem Cells as Angiogenic Cellular Vectors for Revascularizing the Heart.” The award is funded for $36k in total costs.

Anastasia Bilek is co-author, with Professors Dee and Gaver, of “Mechanisms of surface tension induced epithelial cell damage in a model of pulmonary airway reepithelialization,” which will appear in the Journal of Applied Physiology.

Darryl A. Dickerson and Richard M. Morency are finalists in the Bachelor’s-level research competition of the 2002 ASME International Mechanical Engineering Congress and Exposition. This national competition will conclude with their presentations on November 21, 2002, of “Effects of Stimulation Techniques and Culture Time on the Creep of Collagenous Ligament Analogues” (D.A. Dickerson) and “Development and Application of a Combined Imaging and Modelling Technique for Determining Biomechanical Response of Roller Coaster Passengers” (R.M. Morency).


Weiluh Li is the recipient of a $500 Special Travel Award for presenting authors at the Joint EMBS-BMES Conference held in Houston.

Kyle K. White has been awarded the Louisiana Engineering Foundation’s Vincent A. Forte Graduate School Fellowship for 2002. This $2,000 award is presented to students enrolled in a graduate engineering program in one of the universities within the State of Louisiana which has one or more graduate level physics courses for our students. Because his program is advanced by her mentorship of students, Teaching and research opportunities such as these provide the underpinnings for an ever stronger graduate program, and the perception of these activities and successes builds our international reputation in biomedical engineering - as does the brand new book (highlighted below) by Professor Kay C. Dee!

As I had mentioned in last Spring’s newsletter, the Tulane University Biomedical Engineering Board of Advisors, established in 2000, has been meeting each semester to advise and assist the Department Chair regarding the development and operation of the Department. The Board has helped with the Department’s successful ABET re-accreditation and will work with the Department on the upcoming graduate program review. Additionally, the board is helping with fiscal management of the department’s resources. As you will read in the enclosed letter from Rich Ashman, the Board’s Chair, the Board is looking to help build endowment funds for the department. These permanent pins are certainly welcome and your participation helps maintain the sense of community and Esprit de Corps that you felt while on campus.

Please continue to let me know of employment or internship opportunities by e-mailing me (rt hart@tulane.edu) so that I can post it onto our intern newsgroup, tumen_bmen, for students to see. I’d like to build a network of Tulane connections to help our students and alumni.

I hope you enjoy reading about our efforts and successes, that you will take the opportunity to keep current via the network (we updated the website this summer and continue to make improvements) and e-mail, and that you’ll stop by to visit us when you are in town.

Thanks, in advance, for you help and interest in the department – and keep in touch!

Sincerely yours,

Richard T. Hart, Ph.D.
Department Chair
Every heartbeat is triggered by a rapidly propagating electrical excitation wavefront that synchronizes the contractions of the individual cardiac cells. Abnormal propagation of this wavefront, such as a re-entrant wavefront towards the origin (re-entry) severely compromises the mechanical function of the heart. Re-entrant wavefronts represent a major cause of arrhythmias and sudden cardiac death. Sudden cardiac death, primarily caused by rhythm disturbances in the ventricles, the major pumps in the heart, is one of the leading causes of mortality in the United States. It results in more than 450,000 deaths each year. The most effective therapy for the lethal disturbances in cardiac rhythm is the implantable cardioverter defibrillator (ICD), which attempts to re-establish normal rhythmic activity by delivering electrical shocks across the heart (defibrillation). Advances in the clinical procedure of defibrillation have been driven by the device industry resulting in small size and light weight implantable defibrillators requiring a minimally invasive implantation procedure. However, despite the large body of research devoted to defibrillation, the basic mechanisms by which a strong electric shock halts the self-sustained arrhythmia wavefronts still remain incompletely understood.

Understanding the mechanisms of cardiac defibrillation has been hampered by difficulties in recording and interpreting the electrical behavior of cardiac tissue in response to electric shocks. Traditionally, experimental studies of defibrillation have been conducted with the use of computer-assisted electrical mapping systems. However, because of electrode polarization due to the strong electric field, electrical mapping systems could not record signals for up to tens of milliseconds after the shock. Thus, these studies have not been able to resolve numerous issues pertinent to defibrillation, most importantly, what electric events take place during the electric shock.

During the last decade optical mapping techniques that use potentiometric fluorescent dyes have been employed in the study of cardiac defibrillation. These dyes bind to the cell membranes and allow recording of fluorescent signals that are proportional to the potential across the cell membrane. Optical mapping provides valuable information about the electrical behavior during the shock. However, due to photobleaching, the current technique is only capable of recording electrical activity from the surface cells layer of the heart. Activity confined to the depth of the heart remains inaccessible by this recording modality.

Computer simulations of the defibrillation process in the whole heart have the potential to provide the much sought-after shock-induced activity in the depth of the heart. The Computational Cardiac Electrophysiology Laboratory at the Department of Biomedical Engineering at Tulane University directed by Professor Natalia Trayanova has succeeded, for the first time, in the development of a three-dimensional defibrillation model of the rabbit ventricles. The model developed in Dr. Trayanova’s lab incorporates anatomically realistic geometry and fiber architecture (Fig.1), representation of the intracellular and extracellular media within cardiac tissue, the ionic transport across the cell membranes, the effect of the blood on electrical loads in the tissue, as well as the detrimental effects of the shock on cardiac cells, such as electroporation (the formation of holes in the cell membranes due to the strong electric fields in the heart). The model has been verified by comparing the potentials on the ventricular surfaces to those obtained using optical mapping of the rabbit heart. Using this model, Dr. Trayanova’s group has been able to provide the first look into the electrical events taking place within the cardiac walls. The studies conducted in Dr. Trayanova’s lab include termination of arrhythmias with electric shocks as well as the opposite phenomenon, the induction of rhythm disturbances with a strong electric shock delivered to a heart in a normal rhythm. An example of the predictions of the model is shown in Fig. 2.