# WANDA K. NEU, JAMES L. AND ELIZABETH M. VINCENT PROFESSOR

Electroporation-Mediated Drug Delivery and Gene Therapy
Electroporation refers to the creation of small (1-40 nm) pores in the lipid bilayer of the membrane in response to large electric shocks. Electroporation occurs as an undesirable side effect in accidental contacts with high voltage wires or when defibrillation shocks are applied to the heart to prevent sudden cardiac death. However, electroporation has also important applications in biotechnology, as pores allow the introduction of drugs and DNA into cells. Still, this techniques is largely empirical and the results are often variable and difficult to control. Our research in this area concentrates on the development of a model of electroporation that would allow theoretical investigation of the creation of pores during the shock, the flow of ions, drugs, and DNA through pores, and the resulting changes in intracellular concentrations.

Control of Cardiac Arrhythmias Using Nonlinear Dynamics
Cardiac arrhythmias, serious and potentially fatal diseases, can only rarely be successfully controlled with medication. The only available treatment is defibrillation, the delivery of a large electric shock. Such shocks often have serious side effects. Our research investigates the feasibility of alternative treatments for cardiac tachyarrhythmias that instead of large shocks use an appropriately timed train of small pulses. The approach is based on the feedback protocols that have been developed to control the dynamics of complex nonlinear systems and involves animal experiments, mathematical modeling, and computer simulations. These studies allow us to gain a better insight into the dynamics of cardiac rhythm and to assess the feasibility of bringing an episode of arrhythmia under control, terminate it, or even inhibit its occurrence. This research is an interdisciplinary collaboration between Departments of Biomedical Engineering and Physics.

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Teaching (Spring 2010):

- BME 171.01, *SIGNALS AND SYSTEMS* Synopsis
- BME 213.01, *NONLIN DYNAM ELECTROPHYS* Synopsis

Education:

PhD, Duke University, 1987
MS, Mechanical Engineering, 1978

Specialties:

Drug Delivery
Heart, Electrophysiology

Research Interests:

Krassowska Neu's research includes electroporation-mediated drug delivery and gene therapy, and control of cardiac arrhythmias using nonlinear dynamics

Recent Publications (More Publications)

1. X. Zhao and D. G. Schaeffer and C. M. Berger and W. Krassowska and D. J. Gauthier, *Cardiac*

*Alternans Arising From an Unfolded Border-Collision Bifurcation*, Journal Of Computational And Nonlinear Dynamics, vol. 3 no. 4 (October, 2008) [abs].

2. C. M. Berger and X. Zhao and D. G. Schaeffer and H. M. Dobrovolny and W. Krassowska and D. J. Gauthier, *Period-doubling bifurcation to alternans in paced cardiac tissue: Crossover from smooth to border-collision characteristics*, Physical Review Letters, vol. 99 no. 5 (August, 2007) [abs].
3. A. M. Pitruzzello and W. Krassowska and S. F. Idriss, *Spatial heterogeneity of the restitution portrait in rabbit epicardium*, American Journal Of Physiology-heart And Circulatory Physiology, vol. 292 no. 3 (March, 2007), pp. H1568 -- H1578 [abs].
4. D. G. Schaeffer and J. W. Cain and D. J. Gauthier and S. S. Kalb and R. A. Oliver and E. G. Tolkacheva and W. J. Ying and W. Krassowska, *An ionically based mapping model with memory for cardiac restitution*, Bulletin Of Mathematical Biology, vol. 69 no. 2 (February, 2007), pp. 459 -- 482 [abs].
5. W. Krassowska and P. D. Filev, *Modeling electroporation in a single cell*, Biophysical Journal, vol. 92 no. 2 (January, 2007), pp. 404 -- 417 [abs].

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