Louis R. Nemzer, Ph.D.

Experimental and Theoretical Biophysicist
Fulbright Distinguished Chair in Environmental Science

3301 College Avenue | Fort Lauderdale FL 33314
614-598-5289 | lnemzer@nova.edu

Education:

Ohio State University	Ph.D.	Physics, 2010
Ohio State University	M.S.	Physics, 2007
Yeshiva University (Honors Program)	B.A.	Physics, Math (Minor), *Valedictorian*, 2005

Ph.D. Dissertation: Oxidoreductase Immobilization in Reprecipitated Polyaniline Nanostructures for Optical Biosensing Applications *(Adviser: Arthur J. Epstein)*
Undergraduate Thesis: Effect of Interface Disorder on Charge Transport through Quantum Wells

Current Position:
2019-2020: Fulbright Distinguished Chair in Environmental Science, Carleton University (Ottawa, Canada)
2017-Present: Associate Professor, Department of Chemistry and Physics
Halmos College of Natural Sciences and Oceanography, Nova Southeastern University
2012-2017: Assistant Professor

Patents:
1. US Patent #8,326,389: "A System for *in vivo* Biosensing Based on the Optical Response of Electronic Polymers." A J Epstein and L R Nemzer (2012)

Grant Funding:
Nova Southeastern University President's Faculty Research and Development Grants (2018-2019 & 2014-2015)

RESEARCH INTERESTS

Antibiotic Resistance in Bacteria: Over time, antibiotic drugs lose potency as bacteria evolve mechanisms to resist their effects. Excessive use of antibiotics has hastened this process, as susceptible bacteria are selectively killed, allowing the resistant bacteria to proliferate. Our ongoing research attempts to identify the conditions that are most likely to give rise to antibiotic resistance. We use a combination of theoretical models, *Mathematica* computer simulations, and experiments with bacteria. The goal is to discover actionable information to guide clinical decisions regarding how antibiotics are prescribed and administered.

Seizure Prediction for Epilepsy: Real-time detection and prediction of seizures in patients with epilepsy is essential for rapid intervention. We use a computer simulation of networks of neurons to generate artificial EEG signals. We find that situations corresponding to interictal (non-seizure) and ictal (seizure) states are separated by a phase transition that can be influenced by congenital channelopathies, anticonvulsant drugs, and connectome plasticity. The interictal phase exhibits scale-free phenomena, as characterized by a power law form of the spectral power density, while the ictal state suffers from pathological synchronization. We compare the results with intracranial EEG data and show how these findings may be used to detect or even predict seizure onset using TensorFlow machine learning models written in Python.

Information Entropy of the Genetic Code: Genetic mutations in even a single letter of DNA may cause hereditary diseases, including sickle-cell anemia. However, many mutations cause no problems at all. The chance that a single nucleotide polymorphism leads to a diseased state is strongly influenced by the chemical relatedness of the amino acid originally coded and the one actually produced. Many groupings of amino acids into related "families" have been proposed. My research uses the principles of information theory – which has many mathematical connections to the physics concept of thermodynamic entropy and the machine learning method of decisions trees – to examine the inherent error-correcting features of the genetic code and evaluate which groupings best take advantage of its redundancy.

3D-Printing for Data Visualization: Data is more ubiquitous than ever. To better analyze and communicate the meaning of the torrent of information generated from scientific, industrial, financial, and municipal sources - and to facilitate the creation of novel insights, data can be converted into 3D-printed visualizations. In contrast with pseudo-3D visualizations that merely simulate depth on a flat paper or computer screen, physical 3D-printed models can be held, rotated, inspected, and touched to facilitate better understanding of the data.

Publications:

1. How Words Matter: Machine Learning & Movie Success. Forthcoming in *Applied Economics Letters*
2. The public and private benefit of an impure public good determines the sensitivity of bacteria to population collapse in a snowdrift game. In Press at *Environmental Microbiology*
3. Treating epilepsy with physics. *Physics World* Cover Feature Sep. 2019
4. Simulation of Ictal and Interictal Phases on a Small-World Network. *In Preparation*
5. 3D-Printing and Data Visualization. Under review at *Array*.
6. A Binary Representation of the Genetic Code. L R Nemzer *BioSystems* **155** 10–19 (2017)
7. Shannon Information Entropy in the Canonical Genetic Code. L R Nemzer *Journal of Theoretical Biology* **415** 158–170 (2017)
8. Linking Autism and Epilepsy. F Neymotin and L R Nemzer. *Children's Health Care* **45** [1] (2016)
9. Imprisoned Lightning: Charge Transport in Trehalose-Derived Sugar Glasses. L R Nemzer, M S Navati, and J M Friedman. *Ionics* **21** 2211–2217 (2015)
10. The Official Guide to the MCAT® Exam (MCAT2015) *4th Edition*. Association of American Medical Colleges. ISBN 9781577541332 (2014), Participating Author.
11. Locus of Control and Obesity. F Neymotin and L R Nemzer. *Frontiers in Endocrinology: Diabetes* **5** [159] (2014)
12. Enzyme Entrapment in Polyaniline Films Observed via Fluorescence Anisotropy and Antiquenching. L R Nemzer, M McCaffrey, and A J Epstein. *Modern Physics Letters B* **28** [11] (2014)
13. A Model of Band-Pass Phenotypic Resistance in a Modified Beverton-Holt Framework. L R Nemzer. *Mathematical Biosciences* **252** 7–13 (2014)
14. Ethanol Shock and Lysozyme Aggregation. L R Nemzer, B N Flanders, J D Schmit, A Chakrabarti, and C M Sorensen. *Soft Matter* **9** 2187–2196 (2013)
15. Exciton Broadening in Polyaniline Chains during Ion Induced Hydrophobic Collapse and Aggregation. L R Nemzer and A J Epstein. *Synthetic Metals* **161** 2284–2288 (2011)
16. A Polyaniline-Based Optical Biosensing Platform Using an Entrapped Oxidoreductase Enzyme. L R Nemzer and A J Epstein. *Sensors and Actuators B: Chemical* **150** 376–383 (2010)
17. Enzyme Entrapment in Reprecipitated Polyaniline Nano- and Microparticles. L R Nemzer, A Schwartz, and A J Epstein. *Macromolecules* **43** 4324–4330 (2010)
18. Disorder Characterization of Oxide/Silicon Interfaces from I-V Curves. L R Nemzer and F Zypman. *Mat Res Soc* **786** 78 (2004)

Fellowships:

Nanoscale Science and Engineering Center Fellow, 2008-2010
National Science Foundation IGERT Fellow, 2005-2008
Council of Nanoscience Graduate Students Elected Representative, 2006-2007

Previous Positions:

Visiting Scholar, Binghamton University 2017
Postdoctoral Research Associate, Kansas State University, 2010-2011
Physics Studio Instructor for General Physics I and II (Engineering Sequence and Premed Sequence)
Research in Biophysics/Soft Matter Laboratory
Question Writer, MCAT
Scientific Manuscript Editor, Write Science Right, 2011; American Journal Experts, Edanz 2016-
Professional Journal Article Preparation and Revision
Visiting Scientist, Albert Einstein College of Medicine, Biophysics Department, 2007
Research on Charge Transport and Protein Preservation in Vitrified Trehalose Sugar-Glasses
Graduate Teaching Associate, Ohio State University, 2004-2005
Physics Recitation Instructor for General Physics

Technical Skills and Equipment Training:

Mathematica, Python, TensorFlow, Keras, Scikit-learn, UV-VIS/FTIR/Raman Spectroscopy, Dynamic Light Scattering, Circular Dichroic Spectroscopy, Fluorescence Anisotropy, Scanning Electron Microscopy/Focused Ion Beam, Organic Chemistry

Presentations:

2019 Analysis and Applications Seminar Invited Talk – Florida Atlantic University Mathematics Department
Using Machine Learning to Predict Seizures in Patients with Epilepsy
2019 American Physical Society (APS) March Meeting [P67.3]
Seizure Prediction with Machine Learning using Real and Simulated Electrocorticography Data
2018 American Physical Society (APS) March Meeting [R49.3] *Shannon Information Entropy in the Genetic Code*
2017 American Physical Society (APS) March Meeting [R5.6] *Interictal to Ictal Phase Transition in a Small-World Network*
2016 Interdisciplinary Council for the Study of Autism Invited Talk: *Linking Autism and Epilepsy*
2015 Nova Southeastern University Science Colloquium Invited Talk:
Antibiotic Resistance and Game Theory: Convincing Bacteria to Cheat
2015 American Physical Society (APS) March Meeting [T48.8]
A Stochastic Cooperative Agent Model of Band-Pass Antibiotic Resistance
2014 Nova Southeastern University Science Week Invited Talk. *Patently Non-Obvious: A Scientist Observes the US Patent System*
2014 American Physical Society (APS) March Meeting [Q45.3]
Enzyme Entrapment in Polyaniline Biosensors Observed via Fluorescence Anisotropy and Antiquenching
2014 Society of Physics Students (SPS) Invited Talk. *The Physics of the Olympics*
2013 American Physical Society (APS) March Meeting [T33.8] *Charge Transport in Trehalose Sugar Glasses*
2012 Nova Southeastern University Science Week Invited Talk. *Lasers, Proteins, and Alzheimer's*
2012 American Physical Society (APS) March Meeting [H40.4]
Lysozyme Aggregation and Fibrillation Monitored by Dynamic Light Scattering
2011 American Physical Society (APS) March Meeting [T40.2]
Applied Electric Fields and the Aggregation of Highly Charged Proteins
2010 Kansas State University Department of Physics Condensed Matter Seminar: *Salt-Induced*
Precipitation of Polyaniline for Real-Time Analyte Monitoring
2009 American Physical Society (APS) March Meeting [W18.10]
An Optical Biosensing Platform using Reprecipitated Polyaniline Microparticles
2008 Condensed Matter Colloquium Ohio State University Department of Physics: *Electronic and Magnetic Polymers*
2008 Materials Research Society (MRS) Fall Meeting [AA8.8]
A Polyaniline-Based Optical Biosensor for Continuous Glucose Monitoring
2007 Albert Einstein College of Medicine Department of Biophysics:
Imprisoned Lightning: Charge Transport in Trehalose Sugar Glasses
2004 American Physical Society (APS) March Meeting [K1.73] *Transport Through Disordered Silicon Oxide Quantum Structures*

Media Descriptions:

NSU Research Spotlights: *"NSU Biophysicist Studies the "Autocorrect" Feature in your DNA"* (4/10/17)
"Let's Get Physical (with Data)" (8/28/18)
Diabetes Health Website: *"Next Generation Blood Glucose Meters"* (11/5/09)
Medcity News: *"Ohio State University researchers work on 'stick-free' blood glucose monitor"* (10/20/09)
Modern Marvels TV Program: *"Magnets"* First Aired on the History Channel 6/14/06
Columbus Dispatch *"Government Support is Vital to Research"* (1/26/07)
Physics World – Medical Physics Blog *"The physics of epilepsy"* (9/2/19)
Professional Associations: American Physical Society
Associate (Guest) Editor: *Frontiers in Diabetes*
Journal Referee: *Chemical Communications, Synthetic Metals, Computational and Structural Biotechnology, Entropy, PLoS One, Biosystems*
Mentorship: Faculty Adviser for the Society of Physics Students NSU Chapter
Hobbies: 2014 NSU Intramural Racquetball Doubles Champion
Citizenship: U.S.

Awards:

First Place Student Poster: Life Sciences South Florida's (LSSF) STEM Undergraduate Research Symposium, 2018
First Place Student Oral Presentation: NSU Undergraduate Student Symposium, 2017
Ohio State University, First Place in the Physics Graduate Student Poster Competition, 2008
Professor Arnold N. and Bertha Lowan Memorial Award for Excellence in Physics, 2004
Golding Distinguished Scholar, Yeshiva University, 2004