

## **LARRY S. LIEBOVITCH, Ph.D.**

Professor of Physics and Psychology  
Queens College, City University of New York

Email: [Larry.Liebovitch@qc.cuny.edu](mailto:Larry.Liebovitch@qc.cuny.edu)

Personal webpage: <http://people.qc.cuny.edu/Faculty/Larry.Liebovitch/documents/main.html>

Linkedin: <http://www.linkedin.com/pub/larry-liebovitch/5a/725/996>

### **Queens College, City University of New York, Flushing, NY**

2010-present Professor of Physics and Psychology

2010-present Professor of Physics, Graduate Center, City University of New York

2014-2014 Director of Special Projects

2010-2013 Dean, Division of Mathematics and Natural Sciences overseeing the Departments of Biology; Chemistry and Biochemistry; Computer Science; Earth and Environmental Sciences; Family, Nutrition and Exercise Sciences; Mathematics; Physics; and Psychology.

Accomplishments as Dean: <http://people.qc.cuny.edu/Faculty/Larry.Liebovitch/documents/accomplishments.pdf>

### **Columbia University in the City of New York, NY**

2014-present Adjunct Senior Research Scholar

Advanced Consortium on Cooperation, Conflict, and Complexity (AC4)

### **Florida Atlantic University, Boca Raton, FL**

Center for Complex Systems and Brain Sciences

Center for Molecular Biology and Biotechnology

Department of Psychology

Department of Biomedical Science

2008-2010 Associate Dean for Graduate Studies and Programs, Charles E. Schmidt College of Science

2007-2008 Graduate Programs Director, Charles E. Schmidt College of Science

2004-2007 Interim Director, Center for Complex Systems and Brain Sciences

1998-2010 Professor

1993-1998 Associate Professor, tenured: August 1996

### **College of Physicians & Surgeons of Columbia University, NY**

Department of Ophthalmology

1985-1993 Assistant Professor

1982-1985 Associate Research Scientist

1979-1982 N.I.H. Postdoctoral Fellow

### **1978-1979 Mt. Sinai School of Medicine, City University of New York**

Department of Ophthalmology

N.I.H. Postdoctoral Fellow

### **1972-1978 Harvard University, Department of Astronomy, Cambridge, MA**

Ph.D. Astronomy, 1978

A.M. Astronomy, 1973

Thesis: Two dimensional calculation of gas flow in barred spiral galaxies.

Teaching Fellow - Harvard University

Instructor - Cambridge Center for Adult Education

Research Assistant - M.I.T.

### **1968-1972 City College, City University of New York**

B.S. summa cum laude, Physics, 1972

## PROFESSIONAL HONORS AND POSITIONS

Member of the Editorial Board of the *American Journal of Physiology*, Modeling in Physiology Section, 1991-1996  
Chair of the Biophysics Section of the New York Academy of Sciences, 1991-1992

Fellow of the American Physical Society through the Division of Biological Physics, 1995

"For advancing the physics of fractals and chaos and using these methods to analyze and understand biological systems."

Zbigniew Czernicki, Larry Liebovitch, and Wlodzimierz Klonowski: Founding Editors of *Nonlinear Biomedical Physics* published by Biomed Central <http://www.nonlinearbiomedphys.com/>

Series Editor: Springer Series: Computational Social Sciences, <http://www.springer.com/series/11784>, 2015-present

## Grants:

### Principal Investigator:

NIH EY4624 Measurement of Human Corneal Endothelial Fluid Flows 1983-86

Whitaker Foundation: Fractals in Biomedical Signal Processing 1987-90

American Heart Association: Established Investigatorship 1988-93

NIH EY6234 Ion Current Analysis in the Cornea 1986-89

NIH EY6234 Ion Current Analysis in the Cornea (Renewal) 1989-94

NIH EY6234 Ion Current Analysis in the Cornea (Renewal) 1994-99

NSF DUE-9752226 Interactive Fractal and Chaos Units 1998-99

NSF DUE-9980715 Integrated Electronic Curricula Material in Fractals and Chaos 2000-2003

NIH GM63527-01 subcontract, Nonlinear Dynamics of Intracellular Signaling 2001-5

McGuire Foundation Nonlinear Analysis of Cardiac Patient Data 2001-2.

U.S.Navy-ASEE Summer Faculty Research Program with Ira Schwartz, Naval Research Laboratory, Washington, DC 2002.

U.S.Navy-ONR-ASEE Summer Faculty Research Program with Ira Schwartz, Naval Research Laboratory, Washington, DC 2003.

U.S.Navy-ONR-ASEE Summer Faculty Research Program with Ira Schwartz, Naval Research Laboratory, Washington, DC 2004.

NSF Application to attend the NSF IUSE Lab, Leesburg, VA, 2014.

PSC-CUNY Award 68047-00 46 Dynamics of Cooperation and Competition on Small World Networks, 2015.

PSC-CUNY Award # 60089-00 48 Sensor-Based, Approach Analyzing Therapeutic Interactions, \$3,500, 2017.

PSC-CUNY Award # 63037-00 51 Physics of Diffusion to Assess the Vulnerability of Deep Learning Networks, \$3,500, 2019.

Participant: James S. McDonnell Foundation: Intractable Conflict as a Dynamical System, P.I. Peter T. Coleman, Columbia University 2006-2009.

## Fellowships:

International Center for Transdisciplinary Studies, International University of Bremen, Germany, 2006.

## Member of the following professional societies: (\*=currently active)

American Association for the Advancement of Science\*

American Association for Artificial Intelligence

American Astronomical Society

American Physical Society\*

Association for Computing Machinery\*

American Psychological Association\*

Association for Psychological Science\*

Association for Research in Vision and Ophthalmology

Basic Science Council of the American Heart Association

Biophysical Society

International Chemometrics Society

International Neural Network Society

International Society for Eye Research

Mathematical Association of America\*

New York Academy of Sciences

Sigma Xi\*

Society for Chaos Theory in Psychology and Life Sciences\*  
Society for Personality and Social Psychology\*

**Reviewer of grant proposals for the following agencies and foundations:**

AIBS Bioelectromagnetics Review Group for the Office of Naval Research  
Canadian Cystic Fibrosis Foundation  
Department of Energy  
Department of the Army  
Thomas F. and Kate Miller Jeffress Memorial Trust  
Fonds zur Förderung der wissenschaftlichen Forschung (Austrian Science Foundation)  
Marsden Fund (Royal Society of New Zealand)  
Medical Research Council of Canada  
National Institutes of Health  
ad hoc reviewer  
Study Section: VISA special Emphasis  
Study Section: VISA-ZRG(1)  
National Science Foundation  
ad hoc reviewer  
Div. Undergraduate Ed., Course Curriculum, and Lab. Improvement Program Panel  
Human and Social Dynamics (HSD) Program  
Natural Sciences and Engineering Research Council of Canada  
Northwest Health Foundation  
Research Corporation, Tucson AZ  
Whitaker Foundation

**Reviewer of articles submitted to the following Journals:**

Advances in Complex Systems  
American Behavioral Scientist  
American Journal of Physiology  
Animal Behavior  
Annals of Biomedical Engineering  
Biochemica et Biophysica Acta  
Bioelectrochemistry and Bioenergetics  
Bioinformatics  
Biological Cybernetics  
Biophysical Chemistry  
Biophysical Journal  
Bioscience Reports  
Biosensors and Bioelectronics  
Biosystems  
Biotechnology Progress  
Bulletin of Mathematical Biology  
BMC Systems Biology  
Canadian Journal of Physiology and Pharmacology  
Cell Biochemistry and Function  
Cellular and Molecular Biology Letters  
Chaos  
The CLAO (Contact Lens Association of Ophthalmologists) Journal  
Complex Systems  
Croatica Chemica Acta  
Current Eye Research  
Discrete Dynamics in Nature and Society  
Fractals  
Experimental Eye Research  
European Biophysics Journal  
European Journal for Applied Mathematics

Europhysics Letters  
IEEE Transactions on Biomedical Engineering  
Integrative and Comparative Biology  
International Journal of Conflict and Violence  
Investigative Ophthalmology and Visual Science  
Journal of Biological Physics  
Journal of Biomedical Science  
Journal of the Electrochemical Society  
Journal of General Physiology  
Journal of Membrane Biology  
Journal of Neurophysiology  
Journal of Neuroscience Methods  
Journal of Pediatric Gastroenterology and Nutrition  
Journal of Physical Chemistry  
Journal of Physics Communications  
Journal of the Royal Society - Interface  
Journal of Statistical Physics  
Journal of Theoretical Biology  
Journal of Thermal Analysis  
Langmuir  
Mathematical Biosciences  
Molecular Psychiatry  
Nature, Scientific Reports  
Neuroscience Letters  
Nonlinear Dynamics, Psychology, and Life Sciences  
Pediatric Research  
Perception  
Physica A  
Physica D  
Physical Review E  
Physical Review Letters  
Physical Review Research  
Physics Letters  
Plant Biology  
PLoS ONE  
Proceedings of the National Academy of Sciences (USA)  
Proceedings of the Royal Society (London)  
Social Cognition  
Transactions on Biomedical Engineering

**Invited presentations at scientific meetings:**

1983  
4th International Conference on Physicochemical Hydrodynamics, New York, NY  
1987  
IEEE Engineering in Medicine and Biology Society, Boston, MA  
13th IEEE Annual Northeast Bioengineering Conference, Philadelphia, PA  
Workshop on Advanced Methods of Physiological System Modeling, Los Angeles, CA  
1988  
Gordon Research Conference on Theoretical Biology and Biomathematics, Tilton, NH  
Gordon Research Conference on Bioelectrochemistry, Plymouth, NH Workshop on Advanced Methods of Physiological System Modeling, Los Angeles, CA  
World Congress on Medical Physics and Biomedical Engineering, San Antonio, TX  
1989  
American Physical Society - Symposium on Nonlinear Dynamics in Living Systems, St. Louis, MO  
New York Academy of Sciences - Mathematical Approaches to Cardiac Arrhythmias, New York, NY  
1990

9th International Congress of Eye Research, Helsinki, Finland  
NATO Advanced Workshop on Complex Dynamics and Biological Evolution, Hindsø, Denmark  
1991  
2nd Finnish Nonlinear Days, Jyväskylä, Finland  
Federation of the Societies of Experimental Biology of Brazil, Brazilian Congress of Biophysics, Symposium on the Functional and Structural Properties of Macromolecules of Cell Membranes, Caxambu, Brazil  
Stony Brook Biomathematics Conference, Stony Brook, NY  
Contractors Meeting of the Membrane Electrochemistry Program of the Office of Naval Research, Airlie, VA  
Annual Fall Meeting of the Biomedical Engineering Society, Charlottesville, VA  
American Heart Association, Research Fellowship Symposium, Anaheim, CA  
Society for Neuroscience, Symposium on the Dynamical Behavior of Neural Systems, New Orleans, LA  
1992  
Radiation Research Society, Plenary Lecture: An Introduction to Chaos and Its Application to Biology, Salt Lake City, UT  
NATO Advanced Workshop on Stochastic Resonance in Physics and Biology  
San Diego, CA  
The Head and Heart of Chaos: NIH Workshop on Nonlinear Dynamics in Biological Systems, NIH Bethesda, MD  
IEEE Engineering in Medicine and Biology Society, Tutorial: Introduction to Fractals in Biology, Paris, France  
1993  
Hofstra University Biomathematics and Bioengineering Conference, Hempstead, NY  
19th IEEE Annual Northeast Bioengineering Conference: Minisymposium on Fractals and Chaos, Newark, NJ  
17th Annual Cell Kinetics Society Meeting, Richland, WA  
Biophysics of Membrane Transport: Symposium in Memory of Peter Läuger, Konstanz, Germany  
1994  
American Physical Society: Fractals in Biological Physics, Symposium of the Division of Biological Physics, Pittsburgh, PA  
North American Society for the Psychology of Sport and Physical Activity, Preconference Workshop on Complex Systems, Clearwater, FL  
XVII Congress of the International Society for Analytical Cytology, Frontiers in Science Lecture, Lake Placid, NY  
IEEE Engineering in Medicine and Biology Society Workshop on Chaotic Questions: From Theory to Bedside Applications, Baltimore, MD  
Dynamical Neuroscience Workshop, Satellite Symposium of the 24th Annual Meeting of the Society for Neuroscience, Boca Raton, FL  
Artificial Neural Networks in Engineering, Tutorial on Chaos and Fractals, St. Louis, MO  
1995  
Biophysical Society, Workshop in Molecular Biophysics, San Francisco, CA  
American Physical Society: Applications of Artificial Neural Networks and Other Artificial Intelligence Procedures to Chemical Systems, Symposium of the Division of Chemical Physics, San Jose, CA  
Association for Research in Vision and Ophthalmology, Special Interest Group Meeting - Fractals in Ophthalmology: A New Tool for Basic Science and Clinical Diagnosis, Ft. Lauderdale, FL.  
Tumor Heterogeneity Workshop, Kananaskis, Alberta, Canada  
Workshop on the Role and Control of Random Events in Biological Systems, Sigtuna, Sweden  
Flow Cytometry Consensus Meeting of the HIV/AIDS Clinical Trials Network of Canada, Aylmer, Québec, Canada  
1996  
44th Annual Meeting of the Radiation Research Society, Symposium on New Concepts in Tumor Biology/Physiology, Chicago, IL  
Polish-British Workshop on Fractals, Nonlinear Dynamics and Chaos, Zakopane, Poland  
1997  
13th School on Biophysics of Membrane Transport, Ładki Zdrój, Poland  
4-lecture Tutorial at the Polish-Anglo-Saxon-Italian Forum on Nonlinear Biophysics, Ładki Zdrój, Poland  
1998  
American Physical Society: Long-range Correlated Fluctuations in Biological Systems, Symposium of the Division of Biological Physics, Los Angeles, CA  
Association for Research in Vision and Ophthalmology, Special Interest Group Meeting - Morphology and Differentiation in the Transparent Lens, Ft. Lauderdale, FL.  
1999

Membrane Transport and Renal Physiology Workshop, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN

Keynote speaker: Mathematics Awareness Day, Rhode Island College, Providence, RI

Facets of Universality in Complex Systems: Climate, Biodynamics and Stock Market, Schloss Rauischholzhausen, Germany

12th Marian Smoluchowski Symposium on Statistical Physics, Zakopane, Poland

Complexity Research and Biotechnology in Agriculture and Medicine, Bozeman, MT.

University of Minnesota Institute for Mathematics and its Applications Hot Topics Workshop: Scaling Phenomena in Communications Networks, Minneapolis, MN.

VHA Third Annual Conference on Complexity Science and Health Care, Philadelphia, PA.

Dr. Charles Sing, Genetics Conference, Ann Arbor, MI.

2000

MAA Mathematics Curriculum for Health and Life Sciences Students Conference, Virginia Commonwealth University, Richmond, VA.

VHA Complexity Leadership and Learning Network Session, Short Hills, NJ.

Society for Chaos Theory in Psychology and Life Sciences: Physiology Workshop: Nonlinear Dynamics in Health and Disease by Susan Mirow and Larry Liebovitch, Philadelphia, PA.

Modeling and Analysis of Genome-Quantitative Phenotype Relationships, Ann Arbor, MI.

Atelier sur les fractales et modelisation en analyse structurelle et dynamique (Workshop on Fractal Modeling in Structural and Dynamical Analysis"), Montreal, Quebec, Canada.

2001

AMATYC (American Mathematics Association of Two Year Colleges), New Visions in Mathematics Education: A Poster Session Featuring Grants Funded by the National Science Foundation, Toronto, Canada.

2002

BioFlorida, Boca Raton, FL.

Workshop on Biotechnology and Complexity in Agriculture and Medicine, Bozeman MT.

2003

Joint Mathematics Meeting, MAA (Mathematical Association of America) Session on Projects Supported by the NSF Division of Undergraduate Education, Baltimore, MD.

Biomathematics Workshop and Summer School, Instituto de Matematica Pure e Aplicada (Institute for Pure and Applied Mathematics), Rio de Janeiro, Brazil.

Uncertainty and Surprise: Questions on Working with the Unexpected and Unknowable, The Plexus Institute and the Red McCombs School of Business, University of Texas, Austin TX.

Workshop: Nonlinear Methods in Psychology, George Mason University, Fairfax, VA.

2003 Allen Cognitive Network Symposium, Tampa, FL.

2004

St. Olaf College's Fifth Annual Science Symposium, "The Strange Attraction of Chaos: Advances in Understanding Complex Systems" St. Olaf College, Northfield, MN.

Society for Chaos Theory in Psychology and Life Science - Tutorial: Introduction to Fractals and Chaos, Milwaukee, WI.

Workshop on Complexity Science and Healthcare Quality: Crafting an International Research Agenda, Harvard Interfaculty Program for Health Systems Improvement and the Plexus Institute, Durham, NH.

2006

BioQUEST Summer Workshop 2006, Beloit, WI.

Society for Chaos Theory in Psychology and Life Science - Tutorial: Introduction to Fractals and Chaos, Baltimore, MD.

2007

Wilhelm and Else Heraeus Summer School, Statistical Physics of Gene Regulation - From Networks to Expression Data and Back, Jacobs University, Bremen, Germany.

Global Futures Form on Genocide Prevention: Complexity Theory and Genocide Prevention, October 18-19, 2007, Washington DC.

2008

Society for Chaos Theory in Psychology and Life Science - Tutorial: Introduction to Fractals and Chaos, Richmond VA.

2015

Sustaining Peace Conference, Columbia University Teachers College, Keynote Talk, "Mathematics of Human Behavior", March 26, 2015.

Expert Meeting on Peace Sustainability, The Advanced Consortium on Cooperation, Conflict and Complexity (AC4), "Value of a Mathematical Model Based on the Casual Loop Diagrams", New York, NY, October 23, 2015.

**Sessions organized at scientific meetings:**

1991

Workshop on Physical and Mathematical Theories of Ion Channel Gating at the 35th Annual Meeting of the Biophysical Society, San Francisco, CA

Fractals and Mathematical Models at the 17th Annual Northeast Bioengineering Conference, Hartford, CT

1995

Fractals in Molecular Biophysics at the 39th Annual Meeting of the Biophysical Society, San Francisco, CA

Special Interest Group Meeting, Fractals in Ophthalmology: A New Tool for Basic Science and Clinical Diagnosis at the 1995 Annual Meeting of the Association for Research in Vision and Ophthalmology, Ft. Lauderdale, FL

1998

Tutorial: Additional Instructor in Fractal Biology and Chaos in Medicine, March Meeting of the American Physical Society, Los Angeles, CA

2003

Workshop: Introduction to Fractals and Chaos, Society for Chaos Theory in Psychology and Life Sciences, Boston, MA

**Scientific meetings and workshops organized:**

2003

Program Committee, International Nonlinear Sciences Conference: Research and Applications in the Life Sciences, Vienna, Austria.

2005

FAU Center for Complex Systems and Brain Sciences - Plexus Institute Conference: On the Verge: Changing Lives, Organizations and MindsL Complexity Science in a Changing World, Boca Raton and Delray Beach Florida.

2006

Programme Committee, Fractal 2006, Vienna, Austria.

2011

Core Faculty of the DST (Dynamical Systems Theory) Innovation Lab, Sheboygan, WI

<http://conflictinnovationlab.org/lab-2013/>

2012

Core Faculty of the DST (Dynamical Systems Theory) Innovation Lab, Ko Olina, Oahu, HI

<http://conflictinnovationlab.org/lab-2014/lab-focus-2014/>

2019

Co-organizer of the series Networks Dynamics in Society, Culture, and Politics for the Initiative for the Theoretical Sciences at the CUNY Graduate Center: January 31-February 1 2019, February 28-March 1, 2019 and April 4-5, 2019.

**Invited talks at universities, research institutes, corporations and meetups:**

1986

CUNY Mt. Sinai School of Medicine, NY (Dept. of Physiology and Biophysics)

1987

Albert Einstein College of Medicine (Dept. of Physiology and Biophysics)

The City College of New York (Sigma Chi Lecture)

Columbia University (Dept. of Applied Mathematics, Dept. of Ophthalmology, Dept. of Physiology and Biophysics)

Cornell University Medical College (Dept. of Physiology and Biophysics)

New York University (Courant Institute)

Syracuse University (Depts. of Physics and Biophysics)

University of Maryland (Dept. of Physiology)

University of Rhode Island (Dept. of Electrical Engineering)

Weizmann Institute (Dept. of Applied Mathematics)

1988

Columbia University (Dept. of Ophthalmology)  
University of Connecticut Health Sciences (Dept. of Pharmacology) University of Washington (Dept. of Bioengineering)  
1989  
Boston University School of Medicine (Dept. of Physiology)  
State University of New York at Stony Brook (Dept. of Applied Mathematics & State University of New York at Stony Brook (Dept. of Applied Mathematics & Statistics)  
University of Illinois at Urbana (Dept. of Physics)  
Washington University (Jewish Hospital)  
1990  
Columbia University (Dept. of Ophthalmology)  
FDA (Center for Devices and Radiological Health)  
Johns Hopkins University School of Medicine (Dept. of Bioengineering)  
University of Alberta (Dept. of Physiology)  
University of Pennsylvania (Dept. of Physiology)  
1991  
Cornell University Medical College (Dept. of Pharmacology)  
CUNY Mt. Sinai School of Medicine, NY (Dept. of Biomathematical Sciences)  
University of Southern California (Dept. of Biomedical Engineering)  
University of Oulu Finland (Dept. of Physiology)  
Columbia University (Dept. of Developmental Psychobiology)  
City College of New York (Dept. of Biology)  
The Rockefeller University (Biophysics Laboratory)  
Boston University School of Medicine (Dept. of Physiology)  
SUNY Health Sciences at Syracuse (Dept. of Physiology)  
Syracuse University (Dept. of Physics)  
Cornell University (Dept. of Pharmacology, Biophysics Seminar)  
Federal University in Rio de Janeiro (Institute of Biophysics)  
Brazilian Center for Research in Physics (Dept. of Condensed Matter and Spectroscopy)  
Geisinger Medical Center (Weis Center for Research)  
Columbia University (Dept. of Ophthalmology)  
1992  
Emory University (Dept. of Physics)  
The City College of New York (Biomechanics Seminar Series)  
Princeton University (Dept. of Physics)  
University of Utah (Dept. of Applied Mathematics)  
University of Washington (Dept. of Bioengineering)  
University of California at Santa Cruz (Dept. of Chemistry)  
The City College of New York (Levich Institute for Physico-Chemical Hydrodynamics)  
University of Chicago (Depts. of Cardiology and Neurology)  
National Institutes of Health (National Eye Institute)  
Boston University (Dept. of Bioengineering)  
1993  
Rutgers University, Newark (Frontiers in Biomedical Science)  
University of Washington (Dept. of Bioengineering)  
Florida Atlantic University (Center for Complex Systems)  
CUNY Mt. Sinai School of Medicine, NY (Dept. of Biomathematical Sciences)  
University of Helsinki (Institute of Physics)  
1994  
Florida Atlantic University (Dept. of Biology)  
New Jersey Institute of Technology (Dept. of Bioengineering)  
Columbia University (Comprehensive Cancer Center)  
Yale University (Dept. of Cellular and Molecular Physiology)  
Carnegie Mellon University (Dept. of Physics)  
Columbia University (Dept. of Medical Informatics)  
Coulter Corporation (Miami, FL)



Boca Raton Members of the New York Academy of Sciences  
1995

Columbia University (Dept. of Ophthalmology)  
Columbia University (Biophysics Seminar Series)  
University of Alberta, Edmonton, Alberta, Canada (Dept. of Physiology)  
Florida International University (Dept. of Physics)  
Florida Atlantic University (Dept. of Physics)  
1996

Polish Academy of Sciences, Warsaw (Institute of Theoretical Physics)  
Columbia University (Dept. of Ophthalmology)  
University of Rochester (Dept. of Physics and Astronomy)  
1997

Columbia University (Dept. of Ophthalmology)  
Silesian Technical University, Gliwice, Poland (Dept. Physical Chemistry and Polymer Technology)  
University of Bremen, Germany (Center for Complex Systems and Visualization).  
Florida Atlantic University (Dept. of Electrical Engineering)  
1998

Columbia University (Dept. of Ophthalmology)  
Borders, Ft. Lauderdale  
Technion, Haifa, Israel (Dept. of Physiology and Biophysics)  
Technion, Haifa, Israel (Dept. of Physics)  
University of Texas Medical Branch, Galveston, TX (Dept. of Ophthalmology)  
University of Texas Medical Branch, Galveston, TX (Dept. of Physiology and Biophysics)  
1999

Florida Atlantic University (Center for Molecular Biology & Biotechnology)  
Rhode Island College (Department of Mathematics)  
University of Technology, Darmstadt, Germany (Botanical Institute)  
2000

Florida Atlantic University (Dept. of Physics)  
Mayo Clinic, Rochester, MN (Dept. of Biochemistry & Molecular Biology)  
University of Michigan, MI (Center for the Study of Complex Systems)  
Florida Atlantic University (Center for Molecular Biology & Biotechnology)  
University of Technology, Darmstadt, Germany (Botanical Institute)  
GSI (Gesellschaft für Schwerionenforschung) Darmstadt, Germany (Dept. of Material Sciences)  
Dalhousie University, Halifax, Canada (Dept. of Physiology & Biophysics)  
University of Miami School of Medicine (Grand Rounds: Daughtry Family Dept. of Surgery & UM/JM Burn Center)  
2001

Keck Graduate Institute of Applied Life Sciences  
University of Texas Health Science Center Houston (Center for Computational Medicine)  
University of Giessen, Germany (Institute for Theoretical Physics III)  
University of Bremen, Germany (Center for Complex Systems and Visualization and Center for Medical Diagnostic Systems and Visualization)  
Max Planck Institute for Flow Research (Max-Planck-Institut für Strömungsforschung), Göttingen, Germany (Department of Nonlinear Dynamics)  
Syracuse University, New York (Dept. of Physics)  
Florida Atlantic University (Center for Molecular Biology & Biotechnology)  
2002

Naval Research Laboratory, Washington, DC (Plasma Physics Div.)  
2003

Florida Atlantic University (Center for Molecular Biology & Biotechnology)  
2005

Syracuse University (Department of Physics)  
2006

International University Bremen, Germany (International Center for Transdisciplinary Science)  
Florida Atlantic University (Division of Research, Lunch and Learn)

2007

Champlain College, St-Lambert, QC, Canada (Pedagogical Day Winter 2007)

Broward Community College (Davie FL, Pembroke Pines FL)

College of Charleston, Charleston, SC (Biology Department)

Medical University of South Carolina, Charleston SC (Hollings Marine Laboratory)

Florida Atlantic University (Department of Psychology)

MeVis Research Center for Medical Imaging Computing, Bremen, Germany

International Center for Cooperation and Conflict Resolution, Teachers College, Columbia University, New York, NY

2008

Helmholtz Zentrum Munchen, Institute for Bioinformatics and Systems Biology, Munich, Germany

2009

Florida Atlantic University, Frontiers in Science Public Lecture Series, Boca Raton, FL

2010

City College, City University of New York, Department of Chemistry.

2014

Webinar: Human Systems Dynamics Institute - Systems and Peace: Emerging Frontiers Webinar. "What Mathematical Models Can Tell Us About Human Behavior".

[http://www.linkedin.com/redirect?url=https%3A%2F%2Fhdsinstitute.adobeconnect.com%2F\\_a1079188209%2Fp8upnthug5u%2F%3Flauncher=false%26fcsContent=true%26pbMode=normal&urlhash=aeop&trk=prof-publication-title-link](http://www.linkedin.com/redirect?url=https%3A%2F%2Fhdsinstitute.adobeconnect.com%2F_a1079188209%2Fp8upnthug5u%2F%3Flauncher=false%26fcsContent=true%26pbMode=normal&urlhash=aeop&trk=prof-publication-title-link)

Columbia University Faculty Seminar on Complexity Science, Modeling and Sustainability. "Simple Quantitative Measures to Evaluate System Properties: Examples from Social Interactions".

Columbia University, WKCR-FM Interview. <http://www.studentaffairs.columbia.edu/wkcr/audio/ac4-december-0>

2016

Visualizing Sustainable Peace: An Introduction to AC4's Sustainable Peace Project. Columbia University, NY.

Analysis and Models of Social Systems: Sustaining Peace & Human Behavior, Queens College, CUNY, Department of Economics.

2018

L. S. Liebovitch. Mathematical Models and Data Science of Sustainable Peace. Peace, Justice and Human Rights (PJHR) Initiative Colloquium. Florida Atlantic University, Boca Raton, FL. March 20, 2018.

L. S. Liebovitch. Models and Simulations for Maintaining Sustainable Peace in the World. UX + Data / Data + The Greater Good Meetup. New York, NY. May 1, 2018.

L. S. Liebovitch. A Very Basic Introduction to Quantum Computing. Physics Department, Queens College City University of New York. October 15, 2018.

L. S. Liebovitch. What We Know and Don't Know About Complex Systems. Faculty Seminar on Complexity Science, Modeling and Sustainability, Columbia University, New York, NY. November 13, 2018.

L. S. Liebovitch. A Basic Introduction to Quantum Computing: Hardware, Software and Applications. I-SENSE Seminar Series. Florida Atlantic University, Boca Raton, FL. November 16, 2018.

2019

L. S. Liebovitch. 2019. A Basic Introduction to Quantum Computing: hardware, software, and applications. NYC Quantum Computing Meetup, Tata Innovation Center, New York, NY, January 23, 2019.

K. Li, L. S. Liebovitch, and L. Tvrđy. 2019. How Can We Make a College Education Accessible for Everyone? Data + Greater Good Meetup, New York, NY, September 26, 2019.

Larry S. Liebovitch. 2019. Introduction to Quantum Computing. Bridging Math and Computer Science, Queens College CUNY, New York, NY, November 19, 2019.

2020

L. S. Liebovitch. A Basic Introduction to Quantum Computing: hardware, software, and applications. NYC Quantum Computing Meetup, January 16, 2020.

L. S. Liebovitch. A Basic Introduction to Quantum Computing: Hardware, software, and applications. Philadelphia/Harrisburg Quantum Computing Meetup, March 16, 2020.

## TEACHING

### **Harvard University - Teaching Fellow**

Natural Sciences 9 - History and Introduction to Astronomy  
Astronomy 8 - Astronomy for Nonscience Students  
Astronomy 14 - Advanced Astronomy for Nonscience Students

### **Cambridge Center for Adult Education - Instructor**

The Astronomical Universe - astronomy for nonscientists

### **Columbia University, College of Physicians and Surgeons**

Basic Science Course for Residents in Ophthalmology  
Lecture: Why are eyes round?  
Lecture: Intercellular junctions  
Physiology Graduate Course G4001 - Introduction to Membrane Biophysics  
Lecture: Kinetics of ion channels  
Physiology 101F - Human Physiology for Medical and Dental Students  
Laboratory: Resting and action potentials in single muscle fibers  
Anatomy 101F - Microscopic Anatomy for Medical and Dental Students  
Laboratory: Anatomy of the eye

### **University of Jyväskylä, Finland**

International Summer School CH3 - Nonlinear Chemical and Physical Processes in Biology

### **University of Alberta, Alberta, Canada**

Examiner on Ph.D. committee of A. Pece in the Department of Physiology

### **Silesian Technical University, Gliwice, Poland**

Examiner on Ph.D. committee of Z. Siwy in the Department of Physical Chemistry and Polymer Technology

### **University of Technology, Darmstadt, Germany**

Graduiertenkolleg 340 - Fractal Geometry in Biology

### **Jacobs University, Bremen Germany**

Heraeus International Summer School - Statistical Physics of Gene Regulation

### **Florida Atlantic University**

Courses:

Psychology PSY 3213 - Research Methods in Psychology  
Psychology PSY 4906 - Directed Independent Undergraduate Study  
Psychology PSY 5721 - Fractals and Chaos in the Life Sciences  
Psychology PSY 5930 - Fractals and Chaos in the Life Sciences  
Psychology PSY 3502 - Fractals in Psychology  
Psychology ISC 6908 - Directed Independent Graduate Study  
Psychology ISC 6930 - Methods in Complex Systems  
Psychology PSY 6930 - Research in Psychobiophysics  
Mathematics MAT1932 - Mathematics & Science of Fractals  
Psychology PSY 4930 - Psychology of the Internet  
Complex Systems ISC 6937 - Proseminar  
Psychology PSY 5930 - Complexity for the Life Sciences  
Complex Systems ISC 6930 - Seminars in Neuroscience

Master Students -Primary Advisor

Jay Michaels, awarded 2009.

Master Students - Committe Member

T. Holroyd (Psychology), M.A. awarded.  
K. Kogan (Psychology)  
J. Fernandes (Biological Sciences), M.A. awarded.  
R. Deitsch (Chemistry and Biochemistry)  
D. Knickerbocker (Biological Sciences)

Ph.D. Students - Primary Advisor

Lina Shehadeh (Complex Systems and Brain Sciences), Ph.D. awarded 2002.  
Young-Ah Rho (Complex Systems and Brain Sciences) (Co-Advisor), Ph.D. awarded 2009.  
Carey Witkov (Complex Systems and Brain Sciences), Ph.D. awarded 2011.  
Jay Michaels (Psychology) (Primary and later Co-Advisor), Ph.D. awarded 2012.  
Michael Norman (Complex Systems and Brain Sciences), Ph.D. awarded 2012.

Ph.D. Students - Committee Member

C. Anderson (Psychology), Ph.D. awarded.  
T. Dineva (Physics), Ph.D. awarded.  
M. Rockloff (Psychology), Ph.D. awarded.  
Z. Albo (Complex Systems and Brain Sciences), Ph.D. awarded.  
R. Sambrook (Complex Systems and Brain Sciences), Ph.D. awarded.  
R. Gross (Physics). Ph.D. awarded.  
Katharine Kaye McMillan (Psychology), Ph.D. awarded 2005

**Queens College, City University of New York**

Courses:

Astronomy 2 - General Astronomy Lab  
Physics 1214 – General Physics 1  
Physics 1224 - General Physics 2  
Physics 1221 - General Physics Lab 2  
Physics 1451 - Principles of Physics Lab 1  
Physics 204 – Physics for Computer Science - 2  
Physics 260 - Introduction to Modern Physics  
Physics 270 - Physics Applications of Machine Learning and Data Science  
Physics 85200-3 - Introduction to Hardware & Algorithms of Quantum Computing

Ph.D. Students - Committee Member

Dov Lazar Fields (Physics)

**PUBLICATIONS**

**Books:**

J. Bassingthwaighe, L. Liebovitch and B. West. 1994. *Fractal Physiology*. Volume 2 in the series Methods in Physiology from the American Physiological Society. Oxford University Press, New York.  
L. S. Liebovitch. 1998. *Fractals and Chaos Simplified for the Life Sciences*. Oxford University Press, New York.  
C. T. Brown and L. S. Liebovitch. 2010. *Fractal Analysis, Quantitative Applications in the Social Sciences*, Volume 165, SAGE Publications, Los Angeles, CA.  
R. R. Vallacher, P. T. Coleman, A. Nowak, L. Bui-Wrzosinska, L. S. Liebovitch, K. Kugler, and A. Bartoli. 2013. *Attracted to Conflict: Dynamic Foundations of Destructive Social Relations*. Springer, New York.  
U. Strawinska-Zanko and L. S. Liebovitch (Eds.) 2018. *Mathematical Modeling of Social Relationships: What Mathematics Can Tell Us About People*, Springer Series on Computational Social Sciences. ISBN 978-3-319-76765-2 (New York: Springer).

**Chapters in books:**

P. Ganatos, S. Weinbaum, J. Fischbarg, and L. S. Liebovitch. 1981. A hydrodynamic theory for the passage of spherical molecules through an extracellular cleft. In *Adv. Bioengr.*, Ed. Van C. Mow, ASME, N.Y.

- L. S. Liebovitch and S. Weinbaum. 1983 A model of epithelial water transport. In *Fourth Int'l Conf. Physicochemical Hydrodynamics*, Ed. R. Pfeffer, N.Y. Acad. Sci., **404**:54- 56.
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1987. Cellular automata model for interacting cell membrane ion channels. In *Perspectives in Biological Dynamics and Theoretical Medicine*, Eds. S. H. Koslow, A. J. Mandell, and M. F. Shlesinger, N.Y. Acad. Sci., **504**:299-300.
- J. P. Koniarek, J. Fischbarg, and L. S. Liebovitch. 1988. The corneal endothelium: its physiological properties as related to survivability of the cornea. In *Cellular and Molecular Aspects of Eye Research*, Eds. G. C. Lavers and J. H. Chen, Sino-American Tech., NY, pp. 120-128.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1988. Inhibition of water flow across rabbit corneal endothelium by blockers of the glucose transporter. In *The Cornea: Trans. World Congr. Cornea III*, Ed. H. D. Cavanagh, Raven Press, NY, pp. 107-109.
- L. S. Liebovitch. 1989. Introduction to the properties and analysis of fractal objects, processes, and data. In *Advanced Methods of Physiological Systems Modeling Vol. II*, Ed. V. Z. Marmarelis, Plenum, NY, pp. 225-239.
- L. S. Liebovitch and T. I. Tóth. 1990. Fractal activity in cell membrane ion channels. In *Mathematical Approaches to Cardiac Arrhythmias*, Ed. J. Jalife, N.Y. Acad. Sci., **591**:375-391.
- L. S. Liebovitch. 1994. Fractal analysis of channel mechanisms, In *ACS Adv. in Chem. No. 235, Biomembrane Electrochemistry*, Eds. M. Blank and I. Vodyanoy, Am. Chem. Soc., Washington DC, pp. 357-374.
- L. S. Liebovitch. 1994. Single channels: from Markovian to fractal models. In *Cardiac Electrophysiology: From Cell to Bedside, 2nd ed.*, Eds. D. P. Zipes and J. Jalife, W. B. Saunders, Philadelphia, PA, pp. 293-304.
- L. S. Liebovitch, N. A. Arnold, and L. Y. Selector. 1994. Neural networks to compute molecular dynamics. In *Intelligent Engineering Systems Through Artificial Neural Networks Vol. 4*, Eds. C. H. Dagli, B. R. Fernandez, J. Ghosh, and R. T. S. Kumara, ASME Press, NY, pp. 843-848.
- T. H. Haines and L. S. Liebovitch. 1995. A molecular mechanism for the transport of water across phospholipid bilayers. In *Permeability and Stability of Lipid Bilayers*, Eds. E. A. Disalvo and S. A. Simon, CRC Press, Boca Raton FL, pp. 123-136.
- L. S. Liebovitch. 1996. Ion channel kinetics. In *Fractal Geometry in Biological Systems*, Eds. P. Iannaccone and M. Khokha, CRC Press, Boca Raton FL, pp. 31-56.
- L. S. Liebovitch. 1996. Ion channel gating: Markov, fractal, and chaos. In *Neural Engineering*, Eds. Y. Kim and N. Thakor, Springer-Verlag, in press.
- M. A. Wood, P. M. Simpson, L. S. Liebovitch, A. T. Todorov, and K. A. Ellenbogen. 1997. Temporal patterns of ventricular tachyarrhythmias: insights from the implantable defibrillator. In *Sudden Cardiac Death: Past, Present, and Future*, Eds. S. B. Dunbar, K. A. Ellenbogen, and A. E. Epstein, Futura Pub. Co., Mt. Kisco, NY, pp. 103-118.
- L. S. Liebovitch, A. T. Todorov, M. A. Wood, and K. A. Ellenbogen. 1999. When using the mean is meaningless: Examples from probability theory and cardiology. In *Handbook of Research Design in Mathematics and Science Education*, Eds. A. E. Kelly and R. A. Lesh, Lawrence Erlbaum Assoc., Mahwah, NJ, pp. 913-926.
- L. S. Liebovitch and A. T. Todorov. 2000. What Causes Ion Channel Proteins to Open and Close? in *Disorder versus Order in Brain Function*, Eds. P. Arhem, C. Blomberg, and H. Liljenstrom. World Scientific, River Edge, NJ, pp 83-106.
- L. S. Liebovitch, T. Penzel, and J. W. Kantelhardt. 2002. Physiological relevance of scaling of heart phenomena. In *The Science of Fractal Disasters: Climate Disruptions, Heart Attacks, and Market Crashes*, Eds. A. Bunde, J. Kropp, and H. J. Schellnhuber, Springer, Berlin, pp. 258-281.
- L. S. Liebovitch, L. A. Shehadeh, and V. K. Jirsa. 2004. Patterns of genetic interactions: Analysis of mRNA levels from cDNA microarrays. In *Modeling in the Neurosciences: From Biological Systems to Neuromimetic Robotics 2nd Edition*, Eds. G. N. Reeke, R. R. Poznanski, K. A. Lindsay, J. R. Rosenberg, and O. Sporns, CRC Press, New York, pp. 9-24.
- L. S. Liebovitch, L. S. 2005. An introduction to the mathematics and meaning of chaos. In *Uncertainty and Surprise in Complex Systems*, Eds. R. R. McDaniel, Jr., and D. J. Driebe, Springer Verlag, Heidelberg, Germany, pp. 99-105.
- L. S. Liebovitch and Lina A. Shehadeh. 2005. Chapter 5. Introduction to Fractals. In *Tutorials in Contemporary Nonlinear Methods for the Behavioral Sciences Web Book* Eds. M. A. Riley and G. V. Orden, National Science Foundation, Directorate for Social, Behavioral and Economic Sciences, <http://www.nsf.gov/sbe/bcs/pac/nmbs/nmbs.jsp>
- L. S. Liebovitch. 2006. Why the eye is round. In *Biology of the Eye*, Ed. J. Fischbarg, Elsevier, New York, pp. 1-19.
- L. S. Liebovitch, V. K. Jirsa, and L. A. Shehadeh. 2006. Structure of genetic regulatory networks: Evidence for scale free networks. In *Complexus Mundi: Emergent Patterns in Nature*, Ed. M. M. Novak, World Scientific, Singapore, pp. 1-8.

- C. Marr, F. J. Theis, L. S. Liebovitch and M.-T. Huett. 2010. Determining the properties of gene regulatory networks from expression data, In *Handbook of Research on Computational Methodologies in Gene Regulatory Networks*, Eds. S. Das, D. Caragea, S. Welch, and W. H. Hsu, (IGI Publishers, Hershey PA), pp. 405-428.
- L. S. Liebovitch and V. Naudot. 2010. Open problems in the dynamics of the expression of gene interaction networks. In *Frontiers in the Study of Chaotic Dynamical Systems with Open Problems*, Ed. Z. Elhadj and J. C. Sprott, World Scientific, Singapore, pp. 219-229.
- L. S. Liebovitch. 2020. How Fractals Help Us See and Understand the World. In *A Fractal Epistemology for a Scientific Psychology*, Ed. T. Marks-Tarlow, Y. Shapiro, K. P. Wolf, and H. Friedman, pp. 361-371 (Cambridge Scholars Publishing, Newcastle upon Tyne, UK, 2020).

#### Articles:

- L. S. Liebovitch. 1974. Discovery of a new radiation source Z-1 in Taurus. *Quart. J. Royal Astron. Soc.*, **15**:141-145.
- L. S. Liebovitch and S. Weinbaum. 1981. A model of epithelial water transport: the corneal endothelium. *Biophys. J.*, **35**:315-338.
- L. S. Liebovitch, J. Fischbarg, and R. Koatz. 1981. Osmotic water permeability of rabbit corneal endothelium and its dependence on ambient concentration. *Biochim. Biophys. Acta.*, **646**:71-76.
- L. S. Liebovitch and J. Fischbarg. 1982. Effects of inhibitors of passive Na and HCO<sub>3</sub> fluxes on electrical potential and fluid transport across rabbit corneal endothelium. *Curr. Eye Res.*, **2**:183-186.
- J. J. Lim, L. S. Liebovitch, and J. Fischbarg. 1983. Ionic selectivity of the paracellular shunt path across rabbit corneal endothelium. *J. Membrane Biol.*, **73**:95-102.
- N. L. Burstein, J. Fischbarg, L. S. Liebovitch, and D. F. Cole. 1984. Electrical potential, resistance, and fluid secretion across isolated ciliary body. *Exp. Eye Res.*, **39**:771-779.
- L. S. Liebovitch and J. Fischbarg. 1985. Determining the kinetics of membrane pores from patch clamp data without measuring the open and closed times. *Biochim. Biophys. Acta* , **813**:132-136.
- J. Fischbarg, J. Hernandez, L. S. Liebovitch, and J. P. Koniarek. 1985. The mechanism of fluid and electrolyte transport across corneal endothelium: critical revision and update of a model. *Curr. Eye Res.*, **4**:351-360.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1985. A central role for cell osmolarity in isotonic fluid transport across epithelia. *Biol. Cell*, **55**:239-244.
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1986. Optical correlation functions applied to the random telegraph signal: how to analyze patch clamp data without measuring the open and closed times. *Math. Biosci.*, **78**:203-215.
- L. S. Liebovitch and J. Fischbarg. 1986. Membrane pores: a computer simulation of interacting pores analyzed by  $g_1(t)$  and  $g_2(t)$  correlation functions. *J. Theoret. Biol.*, **119**:287-297
- L. S. Liebovitch, J. Fischbarg, J. P. Koniarek, I. Todorova, and M. Wang. 1987. Fractal model of ion-channel kinetics. *Biochim. Biophys. Acta*, **896**:173-180.
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1987. Ion channel kinetics: a model based on fractal scaling rather than multistate Markov processes. *Math. Biosci.*, **84**:37-68.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1987. Inhibition of transepithelial osmotic water flow by blockers of the glucose transporter. *Biochim. Biophys. Acta*, **898**:266-274.
- L. S. Liebovitch. 1987. Patch clamp: currents through single ion channels and a fractal interpretation of their kinetics. *Proc. 13th Northeast Bioengr. Conf.*, Ed. K. R. Foster, IEEE, NY, v.1, pp. 331-332.
- L. S. Liebovitch and J. M. Sullivan. 1987. Fractal analysis of a voltage dependent potassium channel from cultured mouse hippocampal neurons. *Biophys. J.*, **52**:979-988.
- J. P. Koniarek, H.-B. Lee, H. D. Rosskothan, L. S. Liebovitch, and J. Fischbarg. 1988. Use of transendothelial electrical potential difference to assess chondroitin sulfate effect in corneal preservation media. *Invest. Ophthal. Vis. Sci.*, **29**:657-660.
- L. S. Liebovitch. 1988. The fractal random telegraph signal: signal analysis and applications. *Ann. Biomed. Engr.*, **16**:483-494.
- A. J. Huang, M. B. Furie, S. C. Nicholson, J. Fischbarg, L. S. Liebovitch, and S. C. Silverstein. 1988. Effects of human neutrophil chemotaxis across human endothelial cell monolayers on the permeability of these monolayers to ions and macromolecules. *J. Cell. Physiol*, **135**:355-366.
- L. S. Liebovitch. 1989. Testing fractal and Markov models of ion channel kinetics. *Biophys. J.*, **55**:373-377.
- L. S. Liebovitch. 1989. Analysis of fractal ion channel kinetics: kinetic rates, energy levels, and activation energies. *Math. Biosci.*, **93**:97-115.

- J. A. Hernandez, J. Fischbarg, and L. S. Liebovitch. 1989. Kinetic model of the effects of electrogenic enzymes on the membrane potential. *J. Theoret. Biol.*, **137**:113-125.
- L. S. Liebovitch and T. I. Tóth. 1989. A fast algorithm to determine fractal dimensions by box counting. *Phys. Lett. A*, **141**:386-390.
- L. S. Liebovitch and T. I. Tóth. 1990. The Akaike information criterion (AIC) is not a sufficient condition to determine the number of ion channel states from single channel recordings. *Synapse*, **5**:134-138.
- L. S. Liebovitch and T. I. Tóth. 1990. Using fractals to understand the opening and closing of ion channels. *Ann. Biomed. Engr.*, **18**:177-194.
- L. S. Liebovitch and Tibor I. Tóth. 1991. A model of ion channel kinetics using deterministic chaotic rather than stochastic processes. *J. Theoret. Biol.*, **148**:243-267
- L. S. Liebovitch and Tibor I. Tóth. 1991. Distributions of activation energy barriers that produce stretched exponential probability distributions for the time spent in each state of the two state reaction  $A \rightleftharpoons B$ . *Bull. Math. Biol.*, **53**:443-455.
- L. S. Liebovitch and F. P. Czegledy. 1991. Fractal, chaotic, and self-organizing critical system descriptions of the kinetics of cell membrane ion channels, In *Complexity, Chaos and Biological Evolution*, Ed. E. Moskilde, Plenum Press, NY, pp. 145-154
- L. S. Liebovitch and Jan P. Koniarek. 1992. Ion channel kinetics. *IEEE Engr. Med. Biol. Mag.*, **11**:53-56.
- L. S. Liebovitch and F. P. Czegledy. 1992. A model of ion channel kinetics based on deterministic, chaotic motion in a potential with two local minima. *Ann. Biomed. Engr.*, **20**:517-531.
- L. S. Liebovitch, L. Y. Selector, and R. P. Kline. 1992. Statistical properties predicted by the ball and chain model of channel inactivation. *Biophys. J.*, **63**:1579-1585.
- L. S. Liebovitch. 1992. Introduction to fractals in biology. *Proc. Tutorials 14th IEEE Engr. Med. Biol. Soc. Meeting, Paris, France*.
- L. S. Liebovitch. 1993. Interpretation of protein structure and dynamics from the statistics of the open and closed times measured in a single ion channel protein. *J. Stat. Phys.*, **70**:329-337.
- B. Hoop, H. Kazemi, and L. Liebovitch. 1993. Rescaled range analysis of resting respiration. *Chaos*, **3**:27-29.
- L. S. Liebovitch, N. A. Arnold, and L. Y. Selector. 1994. Neural networks to compute molecular dynamics. *J. Biol. Systems*, **2**:193-228.
- L. M. Boxt, J. Katz, L. S. Liebovitch, R. Jones, P. D. Esser, and L. Reid. 1994. Fractal analysis of pulmonary arteries: the fractal dimension is lower in pulmonary hypertension. *J. Thoracic Imaging*, **9**:8-13.
- L. S. Liebovitch. 1995. Book review of *Fractals in Science* by A. Bunde and S. Havlin, eds. *Biophys. J.*, **68**:391-392.
- B. Hoop, M. D. Burton, H. Kazemi, and L. S. Liebovitch. 1995. Correlation in stimulated respiratory neural noise. *Chaos*, **5**:609-612.
- R. A. Nogueira, W. A. Varanda, and L. S. Liebovitch. 1995. Hurst analysis in the study of ion channel kinetics. *Braz. J. Med. Biol. Res.*, **28**:491-496.
- A. M. Churilla, W. A. Gottschalk, L. S. Liebovitch, L. Y. Selector, A. T. Todorov, and S. Yeandle. 1996. Membrane potential fluctuations of human T-lymphocytes have fractal characteristics of fractional Brownian motion. *Ann. Biomed. Engr.*, **24**:99-108.
- L. S. Liebovitch and A. T. Todorov. 1996. Invited editorial on "Fractal dynamics of human gait: stability of long-range correlations in stride interval fluctuations". *J. Appl. Physiol.*, **80**:1446-1447.
- L. S. Liebovitch and A. T. Todorov. 1996. Using fractals and nonlinear dynamics to determine the physical properties of ion channel proteins. *Crit. Rev. Neurobiol.*, **10**:169-187.
- L. S. Liebovitch, Y. Tao, A. T. Todorov, and L. Levine. 1996. Is there an error correcting code in DNA? *Biophys. J.*, **71**:1539-1544.
- L. S. Liebovitch and A. T. Todorov. 1996. What causes ion channel proteins to fluctuate open and closed? *Int'l. J. Neural Systems*, **4**:321-333.
- T. I. Tóth and L. S. Liebovitch. 1996. Models of ion channel kinetics with chaotic subthreshold behaviour. *Zeitschrift für Angewandte Mathematik und Mechanik*, Special Issue 5: 523-524.
- D. Hoyer, L. S. Liebovitch, K. Schmidt, B. Luethke, and U. Zwiener. 1997. Studies of the practical problems of determining the dimension from heart rate data. *Med. Bio. Engr. Comp.*, **35**:27-32.
- L. S. Liebovitch and M. Zochowski. 1997. Dynamics of neural networks relevant to properties of proteins. *Phys. Rev. E*, **56**:931-935.
- L. S. Liebovitch. 1997. Introduction to fractals with examples of biomedical applications. *Int'l. J. Smart Engr. Design*, **1**:15-31.
- M. Zochowski and L. S. Liebovitch. 1997. Synchronization of the trajectory as a way to control the dynamics of the coupled system. *Phys. Rev. E*, **56**:3701-3704.

- J. A. Fernandes, P. L. Lutz, A. Tannenbaum, A. T. Todorov, L. S. Liebovitch, and R. Vertes. 1997. Electroencephalogram activity in the anoxic turtle brain. *Am. J. Physiol.*, **273**:R911-R919.
- L. S. Liebovitch and W. Yang. 1997. Transition from persistent to anti-persistent correlation in biological systems. *Phys. Rev. E*, **56**:4557-4566.
- L. S. Liebovitch and M. Zochowski. 1997. Dynamics of neural networks and their application to ion channel protein dynamics. *Cell. Molec. Biol. Lett.*, 2(Suppl. 1):166-177.
- Z. J. Grzywna, L. S. Liebovitch, and Z. Siwy. 1997. On the self-similarity of the logistic map. *Cell. Molec. Biol. Lett.*, 2:449-466.
- L. S. Liebovitch and M. Zochowski. 1998. Significance of updating schemes in computational models: Dynamics of neural networks. *J. Stat. Phys.*, **90**:253-260.
- J. W. Chapman, E. Wolman, S. R. Wolman, Y. Remvikos, S. Shackney, D. E. Axelrod, H. Baisch, I. J. Christensen, R. A. White, L. S. Liebovitch, D. H. Moore, F. M. Waldman, C. J. Cornelisse, and T. V. Shankey. 1998. Assessing genetic markers of tumor progression in the context of intra-tumor heterogeneity. *Cytometry*, **31**:67-73.
- Z. J. Grzywna, L. S. Liebovitch and Z. Siwy. 1998. A dual mode mechanism of conductance through fine porous membranes *J. Membrane Sci.*, **145**:253-263.
- L. S. Liebovitch, A. T. Todorov, M. Zochowski, D. Scheurle, L. Colgin, M. A. Wood, K. A. Ellenbogen, J. M. Herre, and R. C. Berstein. 1999. Nonlinear properties of cardiac rhythm abnormalities. *Phys. Rev. E*, **59**:3312-3319.
- M. Zochowski and L. S. Liebovitch. 1999. Self-organizing dynamics of coupled map systems. *Phys. Rev. E*, **59**:2830-2837.
- S. B. Lowen, L. S. Liebovitch, and J. A. White. 1999. Fractal ion-channel behavior generates fractal timing patterns in neuronal models. *Phys. Rev. E*, **59**:5970-5980.
- M. A. Wood, K. A. Ellenbogen and L. S. Liebovitch. 1999. Electrical storm in patients with transverse implantable cardioverter-defibrillators *J. Am. Coll. Cardiology*, **34**:950-951.
- L. S. Liebovitch and D. Scheurle. 2000. Two lessons from fractals and chaos. *Complexity*, **5**(No.4):34-43.
- W. A. Varanda, L. S. Liebovitch, J. N. Figueira, and R. A. Nogueira. 2000. Hurst analysis applied to the study of single calcium-activated potassium channel kinetics in Leydig cells. *J. Theoret. Biol.*, **206** 343-353.
- L. S. Liebovitch, D. Scheurle, M. Rusek, and M. Zochowski. 2001. Fractal methods to analyze ion channel kinetics. *Methods*, **24** 359-375.
- L. A. Shehadeh, L. S. Liebovitch, and M. A. Wood. 2002. Temporal patterns of atrial arrhythmia recurrences in patients with implantable defibrillators: implications for assessing antiarrhythmic therapies. *J. Card. Electrophys.* **13**:303-309.
- L. S. Liebovitch and P. Kreckora. 2002. The physical basis of ion channel kinetics: The importance of dynamics. *Institute for Mathematics and its Applications Volumes in Mathematics and its Applications, Membrane Transport and Renal Physiology*, Eds. H. E. Layton and A. M. Weinstein, **129**:27-52.
- L. S. Liebovitch and Ira B. Schwartz. 2003. Information flow dynamics and timing patterns in the arrival of email viruses. *Phys. Rev. E* **68** 017101-1 - 017101-4.
- L. S. Liebovitch and I. B. Schwartz. 2004. Migration induced epidemics: Dynamics of Flux-based multipatch models. *Physics Letters A* **332**:256-267.
- C. T. Brown, W. R. T. Witschey, and L. S. Liebovitch. 2005. The Broken Past: Fractals in Archaeology. *J. Archaeological Method and Theory* **12** :37-78.
- L. A. Shehadeh, L. S. Liebovitch, and V. K. Jirsa. 2006. Relationship between global structures of genetic networks and mRNA levels measured by cDNA microarrays. *Physica A* **364** :297-314.
- L. S. Liebovitch. 2006. What is "Self-Organization"? *Emerging: The Newsletter of the Plexus Institute* April-August 2006, pp. 16-19.
- C. T. Brown, L. S. Liebovitch, and R. Glendon. 2006. Levy flights in Dobe Ju/'hoansi foraging patterns. *Human Ecology* **35**:129-138, DOI 10.1007/s10745-006-9083-4, <http://www.springerlink.com/content/tu8j2353q22u3472/fulltext.pdf>.
- L. S. Liebovitch, N. Tsinoremas, and A. Pandya. 2007. Developing combinatorial multi-component therapies (CMCT) of drugs that are more specific and have fewer side effects than traditional one drug therapies. *Nonlinear Biomedical Physics* **1**:11 (30 August) doi:10.1186/1753-4631-1-1107, <http://www.nonlinearbiomedphys.com/content/pdf/1753-4631-1-11.pdf>.
- Y.-A. Rho, L. S. Liebovitch, and I. B. Schwartz. 2008. Dynamical response of multi-patch, flux-based models to the input of infected people: Epidemic response to initiated events. *Physics Letters A*, **372**:5017-5025. doi:10.1016/j.physleta.2008.05.065
- L. S. Liebovitch, V. Naudot, R. Vallacher, A. Nowak, L. Bui-Wrzosinska, and P. Coleman. 2008. Dynamics of two-actor cooperation-competition conflict models. *Physica A*, **387**:6360-6378. doi: 10.1016/j.physa.2008.07.020



- C. Witkov and L. S. Liebovitch. 2010. Predicting optimal sweep rates for autoresonance in Duffing-type oscillators: A beat method using Teager-Kaiser instantaneous frequency *J. Sound and Vibration* 329:1154-1164. doi:10.1016/j.jsv.2009.10.030
- N. E. Romero, Q. D. Y. Ma, L. S. Liebovitch, C. T. Brown and P. Ch. Ivanov. 2010. Correlated walks down the Babylonian markets *Europhysics Letters* 90:18004. doi: 10.1209/0295-5075/90/18004
- C. Marr, F. J. Theis, L. S. Liebovitch, and M.-T. Huett. 2010. Patterns of subnet usage reveal distinct scales of regulation in the transcriptional regulatory network of *Escherichia coli*. *PLoS Computational Biology*, 6(7): e1000836. doi:10.1371/journal.pcbi.1000836 .
- L. S. Liebovitch, R. Vallacher, and J. Michaels. 2010. Dynamics of cooperation-competition interaction model, *Peace and Conflict: The Journal of Peace Psychology*, 16(2):175-188.
- J. L. Michaels, V. Naudot, and L. S. Liebovitch. 2010. Dynamic stabilization in the PU1-GATA1 circuit using a model with time-dependent kinetic change *Bulletin of Mathematical Biology* doi: 10.1007/s11538-010-9615-3.
- L. S. Liebovitch, Paul R. Peluso, M. D. Norman, J. Su, and J. M. Gottman. 2011. Mathematical model of the dynamics of psychotherapy. *Cognitive Neurodynamics*, doi: 10.1007/s11571-011-9157-x <http://www.springerlink.com/content/14tr224877t3x276/>
- P. R. Peluso, L. S. Liebovitch, J. M. Gottman, and J. Su. 2012. A Mathematical Model of Psychotherapy: An Investigation Using Dynamic Non-linear Equations to Model the Therapeutic Relationship. *Psychotherapy Research*, 22(1):40-55, doi: 10.1080/10503307.2011.622314.
- A. Rojas-Pacheco, B. Obregon-Quintana, L. S. Liebovitch, L. Guzman-Vargas. 2013. Time-delay effects on dynamics of a two-actor conflict model. *Physica A* 392:458-467. <http://dx.doi.org/10.1016/j.physa.2012.09.021>.
- J. L. Michaels, R. R. Vallacher, and L. S. Liebovitch. 2013. Volatile psychological dynamics in social interactions: Attitudes and emotions react asymmetrically to interaction shifts between agreement and disagreement. *Social Psychology and Personality Science* 4:705-713. DOI: 10.1177/1948550613482985
- L. Kurt, K. G. Kugler, P. T. Coleman, and L. S. Liebovitch. 2014. Behavioral and emotional dynamics of two people struggling to reach a consensus about a topic on which they disagree. *PLOS ONE* Published: January 10, 2014 DOI: 10.1371/journal.pone.008460 , <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0084608>
- I Y. Fernandez-Rosales, L. S. Liebovitch, L. Guzmán-Vargas. 2015. The dynamic consequences of cooperation and competition in small-world networks *PLOS ONE* Published: April 30, 2015 DOI: 10.1371/journal.pone.0126234, <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0126234>
- L. Guzman-Vargas, B. Obregon-Quintana, D. Aguilar-Velazquez, R. Hernandez-Perez, and L. S. Liebovitch. 2015. Word-Length Correlations and Memory in Large Texts: A Visibility Network Analysis. *Entropy* 17:7798-7810; doi:10.3390/e17117798 <http://people.qc.cuny.edu/Faculty/Larry.Liebovitch/documents/entropy.pdf>
- L. S. Liebovitch, P. T. Coleman, B. Fisher-Yoshida, J. Fisher, K. Mazzaro, D. Fry, P. Vandenbroeck, and S. Ortiz. 2015. Challenge Problem: Sustainable Peace. Bloomberg Data for Good Exchange (<http://www.bloomberg.com/company/d4gx/>) <http://people.qc.cuny.edu/Faculty/Larry.Liebovitch/documents/d4gx.pdf>.
- H. Knowles III, M. E. Hostetler, and L. S. Liebovitch. 2017. Describing the dynamics, distributions, and multiscale relationships in the time evolution of residential building energy consumption. *Energy and Buildings*. 158:310-325. <https://doi.org/10.1016/j.enbuild.2017.09.071>
- P. T. Coleman, L. S. Liebovitch, and J. Fisher. 2019. Taking Complex Systems Seriously: Visualizing and Modeling the Dynamics of Sustainable Peace. *Global Policy*. 02 June 2019 <https://doi.org/10.1111/1758-5899.12680>.
- E. Baeza-Blancas, B. Obregón-Quintana, C. Hernández-Gómez, D. Gómez-Meléndez, D. Aguilar-Velázquez, L. S. Liebovitch, and L. Guzmán-Vargas. 2019. Recurrence Networks in Natural Languages. *Entropy* 2019, 21(5), 517; <https://doi.org/10.3390/e21050517>.
- L. S. Liebovitch, P. T. Coleman, and J. Fisher. 2019. Approaches to Understanding Sustainable Peace: Qualitative Causal Loop Diagrams and Quantitative Mathematical Models. *American Behavioral Scientist*. Published July 4, 2019. <https://doi.org/10.1177/0002764219859618>
- L. S. Liebovitch, P. T. Coleman, A. Bechhofer, C. Colon, J. Donahue, C. Eisenbach, L. Guzmán-Vargas, D. Jacobs, A. Khan, C. Li, D. Maksumov, J. Mucia, M. Persaud, M. Salimi, L. Schweiger, and Q. Wang. 2019. Complexity analysis of sustainable peace: mathematical models and data science measurements. *New Journal of Physics*. Published 8 July 2019. <https://iopscience.iop.org/article/10.1088/1367-2630/ab2a96>
- P. T. Coleman, J. Fisher, D. P. Fry, L. S. Liebovitch, A. Chen-Carrel, and G. Souillac. 2020. How to live in peace? Mapping the science of sustaining peace: A progress report. *APA American Psychologist*, Advance online publication. <https://psycnet.apa.org/doiLanding?doi=10.1037%2Famp0000745>.
- D. P. Fry, G. Souillac, L. S. Liebovitch, P. T. Coleman, K. Agan, E. Nicholson-Cox, D. Mason, F. Palma Gomez, and S. Strauss. 2021. Societies within peace systems avoid war and build positive intergroup relationships. *Nature*:

Humanities & Social Sciences Communications. Published 18 January 2021. <https://doi.org/10.1057/s41599-020-00692-8>

### Computer Programs:

L. S. Liebovitch. A GUI for the ordinary differential equation model of the Sustainable Peace Map coded in Python 3.4.1 with Tkinter. GitHub, latest commit on May 24, 2018. <https://github.com/LarryLiebovitch/PeaceMath.git>

### Abstracts:

- C. Yuan and L. S. Liebovitch. 1971. Is the Orion arm a major arm? *Bull. Amer. Astron. Soc.*, **3**:440.
- C. Yuan and L. S. Liebovitch. 1972. On the spiral structure of the Milky Way system. *Bull. Amer. Astron. Soc.*, **4**:268.
- L. S. Liebovitch and C. C. Lin. 1978. Two dimensional calculation of gas flow in barred spiral galaxies. *Bull. Amer. Astron. Soc.*, **9**:639.
- L. S. Liebovitch and S. Weinbaum. 1979. A model of water flow in the corneal endothelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, April, p. 282.
- L. S. Liebovitch, R. Koatz, and J. Fischbarg. 1980. Dependence of osmotic permeability on the concentrations of the solutions bathing the rabbit corneal endothelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, April, p. 171.
- L. S. Liebovitch, J. Fischbarg, P. Ganatos, and S. Weinbaum. 1981. Reflection coefficients measured across artificial membranes with small uniform pores. *Fed. Amer. Soc. Exp. Biol. Proc.*, **40**:568
- L. S. Liebovitch, P. Reinach, and J. Fischbarg. 1982. Fluid flow across the frog corneal epithelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 102.
- J. J. Lim, L. S. Liebovitch, and J. Fischbarg. 1983. Effect of bicarbonate concentration on electrical potential difference and ion fluxes across the rabbit corneal endothelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 68.
- J. Fischbarg, L. S. Liebovitch, and J. J. Lim. 1983. Effects of inhibitors of passive sodium, hydrogen and bicarbonate ion movements on electrical potential and fluid transport across rabbit corneal endothelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 68.
- J. Fischbarg, L. S. Liebovitch, I. Antoniu, J. Angel, and D. Neiblum. 1984. Volume regulation by rabbit corneal endothelial cells. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 302.
- L. S. Liebovitch and J. Fischbarg. 1985. Patterns in space and time of ion flows through membrane pores, what the power spectrum doesn't tell you about current noise. Workshop on Noise Analysis, Patch Clamp, and Impedance; *First Int'l Cong. Comp. Physiol. Biochem.*, Springer-Verlag, Berlin.
- L. S. Liebovitch, J. Fischbarg, J. A. Hernandez, and J. P. Koniarek. 1985. Patch clamp data analysis: a new and rapid method to determine pore kinetics without measuring the open and closed times. *Biophys. J.*, **47**:64a.
- J. P. Koniarek, I. Todorova, L. S. Liebovitch, and J. Fischbarg. 1985. Patch clamp studies of rabbit corneal endothelial cells: evidence for an anionic channel in the apical membrane. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 2.
- J. Fischbarg, B. R. Masters, L. S. Liebovitch, and B. Gyi. 1985. Rates of fluid transport consistent with isotonic pumping across rabbit corneal endothelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 2.
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1985. Patch clamp data analysis: a new and more rapid method applied to the study of the rabbit corneal endothelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 3.
- J. P. Koniarek, L. S. Liebovitch, and J. Fischbarg. 1985. Patch clamp studies of in vitro rabbit corneal endothelial cells. *J. Gen. Physiol.*, **86**:20a.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1985. The importance of cell osmolarity for isotonic fluid transport across epithelia. *J. Gen. Physiol.*, **86**:41a.
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1986. Use of correlation functions to study patch clamp data. *Biophys. J.*, **49**:374a.
- J. P. Koniarek, G. Markowitz, L. S. Liebovitch, and J. Fischbarg. 1986. Single channel recordings from rabbit corneal endothelium in vitro. *Biophys. J.*, **49**:365a
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1986. Signal processing of ion current data from one or many channels. *J. Electrochem. Soc. Rev. News*, **133**:124c; *Extend. Abstr.*, **86-1**:674.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1986. Evidence that water permeates cell membranes through the glucose channel. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 84.
- J. P. Koniarek, G. D. Markowitz, L. S. Liebovitch, and J. Fischbarg. 1986. A non-selective cation channel in rabbit corneal endothelium. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 349.

- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1986. Fractal model of ion channel kinetics. *J. Gen. Physiol.*, **88**:34a-35a.
- J. P. Koniarek, B. Small, G. D. Markowitz, L. S. Liebovitch, J. Fischbarg, and A. Spector. 1986. Non-selective cation channels in rabbit corneal endothelium and bovine lens epithelium. *Proc. Int'l Soc. Eye Res.*, **4**:33.
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1987. Fractal model of ion channel kinetics. *Biophys. J.*, **51**:246a.
- L. S. Liebovitch. 1987. The opening and closing kinetics of cell membrane ion channels are fractal. *Bull. Amer. Phys. Soc.*, **32**(3):753.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1987. Evidence that the water channel may be one and the same as the glucose transporter channel in the corneal endothelium. *Fed. Amer. Soc. Exp. Biol. Proc.*, **46**(4):1274.
- L. S. Liebovitch, J. Fischbarg, and J. P. Koniarek. 1987. The kinetics of ion channels in the rabbit corneal endothelium are fractal. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 75.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1987. Further evidence for water permeation through the glucose channel in corneal endothelial cell membranes. *Invest. Ophthalm. Vis. Sci. Suppl.*, March, p. 375.
- L. S. Liebovitch. 1987. Fractal model of ion channel kinetics. *9th Int'l Biophys. Cong., Jerusalem, Israel, Abst.*, p. 193.
- J. P. Koniarek, H.-B. Lee, L. S. Liebovitch, and J. Fischbarg. 1987. Corneal preservation assessed by long term monitoring of transendothelial potential difference. *15th Cornea Res. Conf. Abstr.*, Boston, MA, pp. 41-42.
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1987. Inhibition of osmotic water flow across rabbit corneal endothelium by blockers of glucose transport. *J. Gen. Physiol.*, **90**:16a-17a.
- L. S. Liebovitch. 1987. Fractal kinetics of ion channels. *Proc. 9th Ann. Conf. IEEE Engr. Med. Biol. Soc.*, vol. 1, pp. 65-66
- J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. 1987. Is the water channel across cell membranes none other than the glucose transporter channel? *Prog. Abstr. 9th Conf. Eur. Soc. Comp. Physiol. Biochem.*, Copenhagen, Denmark, p. 66.
- L. S. Liebovitch and H. P. Buisman. 1988. Single channel-like electronic artifact recorded from patch clamp amplifiers. *Biophys. J.*, **53**:265a.
- J. P. Koniarek, H.-B. Lee, R. Akiyama, L. S. Liebovitch, H. Rosskothén, and J. Fischbarg. 1988. Corneal preservation solutions assessed by monitoring the transendothelial potential difference. *Invest. Ophthalm. Vis. Sci. Suppl.*, **29**:450
- H.-B. Lee, R. Akiyama, J. P. Koniarek, L. S. Liebovitch, and J. Fischbarg. 1988. Chondroitin sulfate in corneal preservation solutions assessed by monitoring the transendothelial electrical potential difference. *Asia Pacific Ophthalm. Congr.*, Seoul, Korea, in press.
- L. S. Liebovitch. 1988. Fractal kinetics of ion channels. *Proc. World Cong. Med. Phys. Biomed. Engr., Phys. Med. Biol.*, **33**(Suppl. 1):229.
- R. Akiyama, J. P. Koniarek, L. S. Liebovitch, and J. Fischbarg. 1988. Chondroitin sulfate helps to maintain corneal endothelial function during in-vitro preservation. *Proc. Int'l. Soc. Eye Res.*, **5**:107.
- L. S. Liebovitch. 1989. Ion channel kinetics: has it been proven that channels have only a small number of states? *Biophys. J.*, **55**:199a.
- J. A. Hernandez, J. Fischbarg, and L. S. Liebovitch. 1989. Water transport through a single-file pore: a kinetic approach. *Biophys. J.*, **55**:146a.
- L. S. Liebovitch. 1989. Single ion channel molecules and fractal kinetics. *Bull. Amer. Phys. Soc.*, **34**(3):715-716.
- L. S. Liebovitch. 1989. Methods of chaos applied to study single ion channel currents and epithelial ion transport. *Invest. Ophthalm. Vis. Sci. Suppl.*, **30**:167.
- A. I. Goldman, R. Akiyama, A. Vadasz, J. P. Koniarek, J. Fischbarg, L. S. Liebovitch, and E. A. Balazs. 1989. The effect of crosslinked hyaluronan (Hylans) on corneal endothelial function. *Invest. Ophthalm. Vis. Sci. Suppl.*, **30**:260.
- R. Akiyama, J. P. Koniarek, J. Fischbarg, G. Armand, and L. S. Liebovitch. 1989. Effect of high, medium, and low molecular weight fractions of chondroitin sulfate on corneal preservation. *Invest. Ophthalm. Vis. Sci. Suppl.*, **30**:342.
- T. I. Toth and L. S. Liebovitch. 1989. A deterministic model of ion channels with chaotic behavior having a Markovian-like probability function. *Soc. Neurosci. Abstr.*, **15**:1142.
- L. S. Liebovitch and Tibor I. Tóth. 1990. Ion channel kinetics - a random or a deterministic process? *Biophys. J.*, **57**:317a.
- B. Hoop, H. Kazemi, and L. S. Liebovitch. 1990. Fractal (rescaled range) analysis of resting respiration. *Fed. Amer. Soc. Exp. Biol. Proc. J.*, **4**(4):A1105.
- L. S. Liebovitch and T. I. Toth. 1990. A fast algorithm to determine fractal dimension by box counting. *Bull. Amer. Phys. Soc.*, **35**(4):1029.

- L. S. Liebovitch and T. I. Tóth. 1990.  $K^+$  channel kinetics in the corneal endothelium: switching between open and closed states is deterministic rather than random. *Invest. Ophthalm. Vis. Sci. Suppl.*, **31**(4):361.
- L. S. Liebovitch. 1990. Mathematical descriptions of ion channel gating and their physical interpretation: stochastic Markov, deterministic chaos, and self-organized criticality. *Proc. Int'l. Soc. Eye Res.*, **6**:135.
- L. S. Liebovitch and T. I. Tóth. 1990. Chaotic switching between states that mimics a Markov process. *Proc. 12th Ann. Conf. IEEE Engr. Med. Biol. Soc.*, 1901-1902.
- L. M. Boxt, J. Katz, F. P. Czegledy, L. S. Liebovitch, R. C. Jones, L. M. Reid, and P. D. Esser. 1990. Fractal analysis of pulmonary artery branching patterns in pulmonary hypertension. *Circ.* **82**(No. 4, Suppl. III):100.
- L. S. Liebovitch and F. P. Czegledy. 1991. Model of ion channel kinetics: chaotic motion in a potential that has two local minima. *Biophys. J.*, **59**:404a.
- L. S. Liebovitch and F. P. Czegledy. 1991. Ion channel kinetics: a model based on chaotic motion in a potential that has two local minima. *Invest. Ophthalm. Vis. Sci.* **32**:976.
- J. P. Koniarek, P. Welter, L. S. Liebovitch, J. Fischbarg, and H. Eggers. 1991. Ion channels in extraocular muscle fibers and cultured myoblasts. *Invest. Ophthalm. Vis. Sci.* **32**:1242.
- L. S. Liebovitch. 1991. Ion channel gating: Markov, fractals, and chaos. *Ann. Biomed. Engr.* **19** (No. 5): 617.
- L. S. Liebovitch. 1991. The opening and closing of an ion channel protein could be either a random or a deterministic process. American Heart Association, Research Fellowship Symposium.
- L. S. Liebovitch. 1991. Fractal activity and kinetics of ionic channels. *Soc. Neurosci. Abstr.* **17**(Part 1):705.
- L. S. Liebovitch and Tibor I. Tóth. 1992. Distributions of activation energy barriers that yield fractal time dependence in the kinetics of ion channels or ligand binding. *Biophys. J.*, **61**:A249.
- B. Hoop, M. D. Burton, I. Soto-Arape, L. Liebovitch, and H. Kazemi. 1992. Fractal analysis of spontaneous brainstem ventilatory output. *FASEB J.*, **6**(No. 5):A2013.
- L. S. Liebovitch and L. Y. Selector. 1992. Predictions of the ball and chain model of channel inactivation. *18th IEEE Annual Northeast Bioengr. Conf.*, ed. W. J. Ohley. IEEE, Piscataway, NJ, pp. 1-2.
- L. S. Liebovitch and Tibor I. Tóth. 1992. Different types of ion channel kinetics are due to different types of distributions of activation energy barriers between channel substates. *Invest. Ophthalm. Vis. Sci.* **33**:1108.
- J. P. Koniarek, P. A. Welter, L. S. Liebovitch, and H. Eggers. 1992. Botulinum toxin induced ion channels in extraocular muscle fiber membranes. *Invest. Ophthalm. Vis. Sci.* **33**:1099.
- L. S. Liebovitch. 1992. Structural and dynamic interpretation of the fractal scalings of the open and closed time distributions from single channel recordings. *Proc. Annual International Conf. IEEE Engr. Med. Biol. Soc.* **14**:95-96.
- L. S. Liebovitch, L. Y. Selector, and R. P. Kline. 1993. Ion channel inactivation: is it really a ball tethered on a chain? *Biophys. J.*, **64**:A227.
- W. A. Gottschalk, S. Yeandle, A. M. Churilla, L. S. Liebovitch, and L. Y. Selector. 1993. Fluctuating membrane potential, recorded by the whole cell patch clamp technique, of human T lymphocyte cell lines; evidence that it is a fractal of the kind produced by fractional Brownian motion. *Biophys. J.*, **64**:A223.
- T. H. Haines and L. S. Liebovitch. 1993. P-lipid lateral diffusion, water transport and the order parameter: a molecular model of water transport through bilayers. *Biophys. J.*, **64**:A184.
- L. S. Liebovitch. 1993. Fractals in biology. *Proc. 1993 IEEE 19th Annual Northeast Bioengr. Conf.*, ed. J. K.-J. Li and S. S. Reisman. IEEE, Piscataway, NJ, pp. 219-220.
- L. S. Liebovitch, L. Y. Selector, and R. P. Kline. 1993. Predictions of the ball and chain model of ion channel inactivation. *Invest. Ophthalm. Vis. Sci.* **34**:1444.
- J. P. Koniarek, L. S. Liebovitch, and H. Eggers. 1993. Ion channel characteristics in extraocular muscle fiber types. *Invest. Ophthalm. Vis. Sci.* **34**:1497.
- L. S. Liebovitch, N. D. Arnold, and L. Y. Selector. 1994. Neural networks to compute molecular dynamics. *Biophys. J.*, **66**:A391.
- L. S. Liebovitch, N. D. Arnold, and L. Y. Selector. 1994. Neural networks to compute molecular dynamics. *Bull. Amer. Phys. Soc.*, **39**(1):755.
- L. S. Liebovitch. 1994. Fractal analysis of the dynamics of conformational changes in channel proteins. *Bull. Amer. Phys. Soc.*, **39**(1):648-649.
- L. S. Liebovitch, N. D. Arnold, and L. Y. Selector. 1994. Neural networks to compute motion in molecules. *Invest. Ophthalm. Vis. Sci.* **35**:1452.
- L. S. Liebovitch. 1994. An introduction to chaos in biology: simple systems can do complicated things. *Cytometry*, Oct. 1994, Suppl. 7, 9.
- L. S. Liebovitch. 1995. Computing the motions in molecules by using neural networks. *Bull. Amer. Phys. Soc.*, **40**(1):652.

- L. S. Liebovitch and T. H. Haines. 1995. Water transport across lipid bilayers is linked to the lateral diffusion of lipids. *Invest. Ophthalm. Vis. Sci.* **36**(4):S585.
- L. S. Liebovitch, Y. Tao, A. T. Todorov, and L. Levine. 1996. Is there an error correcting code in the base pair sequence of DNA? *Biophys. J.*, **70**:A157.
- A. T. Todorov, L. S. Liebovitch, L. Y. Selector, A. M. Churilla, W. A. Gottschalk, and S. Yerandle. 1996. Fluctuations of the transmembrane voltage have a fractal form. *Invest. Ophthalm. Vis. Sci.*, **37**(3):S1109.
- L. S. Liebovitch, A. T. Todorov, M. A. Wood, J. M. Herre, R. C. Berstein, and K. A. Ellenbogen. 1997. How to analyze data when the mean and variance are not defined. *Biophys. J.*, **72**(2):A105.
- J. P. Koniarek, J. D. Auran, C. J. Koester, and L. S. Liebovitch. 1997. Fractal analysis of corneal innervation. *Invest. Ophthalm. Vis. Sci.* **38**(4):S396.
- L. S. Liebovitch, Y. Tao, A. T. Todorov, and L. Levine. 1997. Error correcting codes in DNA bases. *Invest. Ophthalm. Vis. Sci.* **38**(4):S589.
- L. S. Liebovitch. 1998. What information is stored in DNA: Does it contain a digital error correcting codes? *Bull. Am. Phys. Soc.*, **43**(1):205-206.
- B. J. West, L. S. Liebovitch, and H. E. Stanley. 1998. Tutorial: Fractal biology and chaos in medicine. *Bull. Am. Phys. Soc.*, **43**(1):xii.
- L. S. Liebovitch and M. Zochowski. 1998. Control of target systems using Lyapunov exponents. *Bull. Am. Phys. Soc.*, **43**(1):237.
- L. S. Liebovitch, A. T. Todorov, M. Zochowski, D. Scheurle, L. Colgin, M. A. Wood, K. A. Ellenbogen, J. M. Herre, and R. C. Bernstein. 1998. Scaling properties of the time intervals between arrhythmic events in the heart, Society for Chaos Theory in Psychology and the Life Sciences Newsletter **5**(4):11.
- L. S. Liebovitch, S. B. Lowen, and J. A. White. 1999. Molecular basis of the fractal timing of action potentials. *Invest. Ophthalm. Vis. Sci.* **40**(4):S644.
- Z. Albo, P. Krekora, G. Viana Di Prisco, L. S. Liebovitch and R. P. Vertes. 1999. Linear and fractal analysis of single-unit activity in the thalamic anterior ventral nucleus. Dynamical Neuroscience VII, Delray Beach Oct. 21-22, 1999.
- L. S. Liebovitch, L. A. Shehadeh, and V. K. Jirsa. 2002. New methods to analyze mRNA levels in cDNA microarrays. Biotech 2002 at Florida Atlantic University, Boca Raton, FL.
- L. A. Shehadeh, L. S. Liebovitch, V. K. Jirsa. 2002. Analysis of connectivity patterns and their application to genetic networks. Coordination Dynamics 2002, Delray Beach, FL.
- K. W. Foster, K. Josef, M. J. Korenberg, R. J. Lange, L. S. Liebovitch, E. D. Lipson, D. Mitchell, and J. Saranak. 2002. Toward an integrated analysis of biological function within a single cell: the phototaxis system of *Chlamydomonas*. 10th International Conference on the Cell and Molecular Biology of *Chlamydomonas* Vancouver, Canada, June 11-16, 2002.
- L. Liebovitch, L. Shehadeh, and V. Jirsa. 2003. How genes regulate other genes. International Nonlinear Science Conference: Research and Applications in the Life Sciences, Vienna Austria, February 7-9, 2003.
- Networks of gene regulation determined by mRNA levels measured by cDNA microarrays. Association for Research in Vision and Ophthalmology, Ft. Lauderdale FL, May 4-9, 2003, Abstract #1293.
- L. Liebovitch, V. Jirsa. 2003, and L. Shehadeh. 2003. Determining the network of genetic regulation from cDNA microarrays. Society for Chaos Theory in Psychology and Life Sciences, Boston MA, August 8-10, 2003.
- L. S. Liebovitch and I. B. Schwartz. 2004. Arrival times of e-mail viruses provide information about the structure and dynamics of the internet. Society for Chaos Theory in Psychology and Life Sciences, Milwaukee WI, July 15-18, 2004.
- L. S. Liebovitch, N. Tsinoremas, and A. Pandya. 2006. Analysis of Biological Networks by Artificial Neural Networks. Society for Chaos Theory in Psychology and Life Sciences, Baltimore, MD, August 3-6, 2006.
- L. S. Liebovitch, L. A. Shehadeh, V. K. Jirsa. 2006. Different types of networks of gene interactions are identifiable by the statistics of their mRNA expression. Society of Environmental Toxicology and Chemistry, North American Meeting, Montreal, Quebec, Canada, November 5-9, 2006.
- L. S. Liebovitch, R. Vallacher, A. Nowak, L. Bui-Wrzosinska, and P. Coleman. 2007. Dynamics of Two-Actor Cooperation-Competition Conflict Models. International Association for Conflict Management, July 4, 2007, Budapest Hungary.
- N. Romero, L. S. Liebovitch, and C. T. Brown. 2007. Long Term Agricultural Commodities from Ancient Babylon to Modern England, ICCS 2007, October 29, 2007, Boston MA.
- L. S. Liebovitch, R. Vallacher, A. Nowak, L. Bui-Wrzosinska, A. Bartoli, and P. T. Coleman. 2007. Intractable Conflict as a Dynamical System. International Conference on Complex Systems, ICCS 2007, October 30, 2007, Boston MA.

- L. S. Liebovitch and Vincent Naudot. 2008. Dynamics of Conflicts: Mathematical Models of the Interactions Between Two Actors. Society for Chaos Theory in Psychology and Life Sciences, August 8-10, 2008, Richmond VA.
- L. S. Liebovitch and A. Pandya. 2008. Advantages of Multiple Drug Interactions: Combinatorial Treatments Using Neural Networks. 2nd World Conference on Magic Bullets (Ehrlich II) October 3-5, 2008 Nuremberg, Germany.
- L. S. Liebovitch, R. R. Vallacher, J.L. Michaels, and V. Naudot. 2009. Can equations tell us something new about people in conflict?, Society for Personality and Social Psychology, February 7, 2009, Tampa FL, p. 73.
- J. L. Michaels, L. S. Liebovitch, R. R. Vallacher, V. Naudot. 2010. Changing Cooperation to Competition Disrupts Attitudes and Valence: First Test of a Dynamical Model. Society for Personality and Social Psychology, January 29, 2010, Las Vegas, NV, p. 192.
- L. S. Liebovitch, P. R. Peluso, J. Su, J. Gottman. 2010. Mathematical Model of Psychotherapy - A New Approach to Understanding the Therapeutic Relationship. Association for Psychological Science, May 29, 2010, Boston MA.
- L. S. Liebovitch, A Javid, T. Schiebler, K. Kugler, and L. Kurt. 2015. The Social Influence of Previous Choices on the Subsequent Choices of Users in Polling Software, Association for Psychological Science 27<sup>th</sup> Annual Convention, New York, NY, May 22, 2015.
- L. S. Liebovitch, P. T. Coleman, N. Burgess, D. Futran, D. Lee, T. Lichter, J. Donahue. Sustainable Peace Map: Mathematical Analysis. 29th Annual International Association for Conflict Management (IACM) Conference in New York City, June 26 – 29, 2016.
- L. S. Liebovitch, U. Strawinska-Zanko, J. Michaels, Y. Tan. Understanding the Dynamics of Conflict and Its Management in Intrapersonal, Dyadic, and Group Context. 29th Annual International Association for Conflict Management (IACM) Conference in New York City, June 26 – 29, 2016.
- P. T. Coleman, L. S. Liebovitch, K. Rucki, J. Fisher. Mapping the Science of Sustainable Peace. 29th Annual International Association for Conflict Management (IACM) Conference in New York City, June 26 – 29, 2016.
- P. T. Coleman, L. S. Liebovitch. Rethinking Social Conflict Across Time and Space: The Case for Dynamics. 29th Annual International Association for Conflict Management (IACM) Conference in New York City, June 26 – 29, 2016.
- D. P. Fry, L. S. Liebovitch, J. Donahue, and D. Gilchrist. The Core Dynamics of Sustainable Peace: Understanding and synthesizing the science across disciplines. 2017 Conference of the Peace and Justice Study Association. Birmingham, Alabama, Oct. 25-28, 2017.
- P. T. Coleman, J. Fisher, D. Fry, and L. S. Liebovitch. The Sustaining Peace Project: Synthesizing and Modeling the Science of Sustainable Peace Research, Practice, and Policy. PEACECON2018, Annual Conference of the Alliance for Peacebuilding. United States Institute of Peace, Washington DC, October 24, 2018.
- L. S. Liebovitch. 2019. Mathematical Models and Data Science Measurements of Sustainable Peace. Data for Peace and Society, New York University Center on International Cooperation, New York, NY, March 20, 2019.
- P. T. Coleman, D. P. Fry, G. Souillac, L. S. Liebovitch, J. Fisher, and A. Chen- Carrel. 2019. What Does It Take To Live In Peace? Modeling and Measuring Sustainable Peace For Research and Policy. International Association for Conflict Management, Dublin, Ireland, July 7-9, 2019.
- H. Telang, A. Peshin, A. Joshi, A. Chen-Carrel, L. S. Liebovitch, P. T. Coleman. 2019. Employing NLP Techniques to Analyze Traits of Sustainably Peaceful Societies. Bloomberg Data for Good Exchange 2019. New York, NY. September 15, 2019.
- P. T. Coleman, J. Fisher, D. P. Fry, and L. S. Liebovitch. 2019. What Does It Take to Live in Peace? 2019. Building Sustainable Peace: Ideas, Evidence, Strategies, KROC Institute for International Peace Studies, Notre Dame University, South Bend IN, November 7-10, 2019.

## **PATENTS**

U.S. Patent # 4,959,355. 1990. J. Fischbarg, L. S. Liebovitch, and J. P. Koniarek. Method of inhibiting osmotic water flow.