Five Year Review
Self-Study Report

Center for Neurodynamics

College of Arts and Sciences
University of Missouri at St. Louis

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Table of Contents

1. Overview: History, Mission and Goals of the Center for Neurodynamics………...3
   1.1 Mission of the Center for Neurodynamics.............................................. 3
   1.2 Governance of the Center for Neurodynamics........................................ 3
   1.3 History of the Center for Neurodynamics (1996-2003) ..............................4
   1.4 History of the Center for Neurodynamics (2003-2008) ..............................4
   1.5 Goals of the Center for Neurodynamics............................................... 5
   1.6 Facilities.......................................................................................... 5
   1.7 Personnel (2003-2008) ...................................................................... 8
   1.8 Contributions to Campus Identity....................................................... 9
   1.9 Relation with Academic Departments............................................... 11
   1.10 Changes since 2003 Program Review............................................. 12

2. Review and Assessment of the Center for Neurodynamics.........................12
   2.1 Size, diversity and scholarship .................................................. 12
   2.2 Annual evaluation of scholarly and creative success..............................13
   2.3 Recruitment of personnel and fostering of scholarship..........................13
   2.4 Scholarly activities 2003-2008..................................................... 14
   2.5 Funding 2003-2008........................................................................... 14
   2.6 Use of information technology...................................................... 16

3. Five-Year Plan for the Center for Neurodynamics.....................................16

Appendices..................................................................................................18
1. Overview: History, Mission and Goals of the Center for Neurodynamics

1.1 Mission of the Center for Neurodynamics

The mission of the Center for Neurodynamics remains, as described in the previous self-study, to fulfill the objectives of the Mission Statement of the University of Missouri – St. Louis, specifically

- to maintain a commitment to advance knowledge as part of a comprehensive research university, and
- to contribute significantly to theoretical and applied research in the fields of its faculty scholars.

The Center further advances the mission of the University by

- providing quality undergraduate and graduate research experiences to students from the urban St. Louis region,
- forming successful collaborative partnerships regionally within the metropolitan community, as well as internationally, and
- helping to raise the University’s national and international profile by publications in major scientific journals and presence at major scientific meetings both within the United States and abroad.

During the years since the previous self-study, the Center has continued to pursue this mission. However, the Center has seen significant changes over the past five years. In Section 1.2 below, we review the history of the Center up to 2003. In Section 1.3, we provide an overview of how the Center has changed and grown over the past five years.

1.2 Governance of the Center for Neurodynamics

The Center is an entity of the St. Louis campus of the University of Missouri. The general governance of the Center is by a three voting member Board, consisting of one person each representing the Department of Biology and the Department of Physics plus a Director. Additional nonvoting members can be added as approved by the Board. The board determines general policy for the Center. The Board elects the Director who will also be a member of the Board. The Board also elects one of its own members to be its Chairperson. The day-to-day operations of the Center are governed by a Director and an Associate Director. The Director reports directly to the Vice Provost for Research and through that office to the Provost.

As of the end of the Board meeting of March 10, 2006, the current Board members were Dr. Sonya Bahar, Director, Dr. Lon Wilkens, Associate Director, Dr. Steve Lehmkuhle, member, and Dr. Frank Moss, nonvoting member. With the retirement of Dr. Moss, and Dr. Lehmkuhle’s departure from the UM system, the board, as of March 2008 is comprised of two members, Drs. Bahar and Wilkens.
1.3 History of the Center for Neurodynamics (1996-2003)

The Center for Neurodynamics was founded in 1996 by Frank Moss, Lon Wilkens and Steve Lehmkuhle. Initial studies focused on the role of noise and nonlinear dynamics in biological systems, leading to the first demonstration of behavioral stochastic resonance in a living animal, the paddlefish. As described in the previous five-year report, the Center’s initial objective centered on the goal of elucidating the role of noise and low dimensional dynamics in biological sensory systems. This objective was soon expanded to include topics in the physics domain such as information measures, oscillators, stochastic resonance, unstable periodic orbits, and pattern formation in ensembles of agents. In the biological domain, many of the same concepts were being applied to mechanisms of sensory transduction and information transfer in living model systems including the paddlefish electrosensory system and the mechanosensory and extra retinal photic systems of the crayfish. The dynamics of sensory biology and behavior are also being investigated at the population level in the complex vortex patterns characteristic of plankton communities, phenomena observed in many other animal groups.

These studies led to numerous publications in major scientific journals, including several articles in *Nature*. Supported by a University Research Initiative (URI) grant of $1.9 million from the Office of Naval Research, as well as by grants from the National Institutes of Health (R01 grant), the Defense Advanced Research Projects Agency (DARPA), the Fetzer Institute, the Department of Energy, and the National Science Foundation, the Center was, as it continues to be to this day, entirely self-supporting from research grants.

1.4 History of the Center for Neurodynamics (2003-2008)

The years since the previous five-year review have been years of both growth and change for the Center. In the previous five-year review, the review panel raised the important issue that both Dr. Moss and Dr. Wilkens were “retirement eligible”, and that it was critical for the future of the center to recruit new biological physics faculty to UMSL. This major recommendation of the previous self-study was met when Dr. Sonya Bahar joined the Center for Neurodynamics and the Department of Physics and Astronomy in August 2004.

Dr. Bahar has substantially added to the Center’s roster of projects, retaining the focus on nonlinear dynamics in neural systems, but extending the Center’s studies to include the spatiotemporal dynamics of the mammalian brain, specifically, imaging and computationally modeling the spread of seizure activity in the rat neocortex. Dr. Bahar received a Presidential Early Career Award for Scientists and Engineers (PECASE) for this project in November 2007.

Other new collaborations include the application of nonlinear dynamics based synchronization analysis methods to various clinical brain imaging methods such as functional magnetic resonance imaging (fMRI, in collaboration with researchers at
Washington University in Saint Louis) and magnetoencephalography (MEG, in collaboration with clinicians at Saint Louis University Hospital). Bahar’s group is also collaborating with researchers at Weill Cornell Medical College of Cornell University, to apply nonlinear stochastic phase synchronization methods to assessing traumatic brain injured patients. As part of this collaboration, Bahar’s group has joined with various other universities, including Cornell, UCSF, Washington University, Columbia University and New York University as part of the TBI-BRAINs (Traumatic Brain Injury Blast Research, Attention, Interventions, Neurodiagnostics, and Scientific Guidelines) Research Consortium.

Another major change in the Center for Neurodynamics has been Dr. Wilkens’s establishment of a major collaboration with Dr. Michael Hofmann of the University of Bonn. Drs. Wilkens and Hofmann together obtained a half-million dollar NSF grant for their collaborative study of the neurophysiology and histology of the paddlefish electroreceptor system. Dr. Hofmann is currently working at the University of Missouri – St. Louis, conducting these NSF-funded studies together with Dr. Wilkens. The collaboration with Dr. Hofmann has resulted in an extensive exchange program with the Institute of Zoology, University of Bonn. Six students and two postdoctoral associates have joined Wilkens’ laboratory for varying periods of 3 months to 3 years, and another student, another postdoc, and the Head Professor of Zoology will visit in 2008 to conduct research projects.

1.5 Goals of the Center for Neurodynamics

1. To educate undergraduate students, graduate students, postdoctoral scholars, and the public at large, at the interdisciplinary frontier between physics and biology.
2. To apply physics-based and neurophysiological techniques to the understanding of animal sensory systems, such as the paddlefish electroreceptor system.
3. To investigate the role of stochastic synchronization in mammalian brain pathologies such as epilepsy, using both experimental and computational approaches
4. To investigate the role of noise in modulating neuronal activity and other collective dynamical behaviors of biological systems
5. To apply nonlinear dynamical techniques to the study of human brain activity.
6. To apply nonlinear dynamical techniques to the study of complex collective behavior in biological systems.

1.6 Facilities

A. Facilities based in the Department of Physics and Astronomy:

Four laboratories are available to the Center located in the Department of Physics and Astronomy. They are Benton 333, 1,100 square feet; Research 401, 1,100 sq. ft., Research 404, 1,100 sq. ft., and Benton 449, 550 sq. ft. All except Benton 449 are equipped with hot and cold running water, sink drains, laboratory furniture such as workbenches etc, suitable
electrical outlets and computer campus network connections. Dr. Bahar also has approximately 100 sq. ft. of office space (Benton 503E).

Research 401 is the simulation lab, and also serves as office space for graduate students and for Research Assistant Professor Vassiliy Tsytsarev. Research 401 also houses a PowerPoint beamer and projection screen for the Center’s weekly lab meetings and for informal talks given by Center guests. Research 401 contains seven computer workstations, including three dual-processor Dell Precision Workstations, and is equipped with wireless internet access.

Research 404 is the Center’s brain imaging laboratory. This laboratory is equipped with a fume hood, vacuum and gas taps, and wireless internet access. Laboratory equipment consists a 16-bit Cascade 512B CCD Camera (Roper Scientific), capable of recording one frame every 3 msec, with a computer running MetaMorph 6.1 software for data acquisition; the MacroRey (Optical Imaging Inc, 2006) is installed on the camera and have a set of optic filters for the voltage sensitive dye imaging; Cambridge Electronic Design Power 1401 system with Spike 2 software (version 5.11) for data acquisition; a stereotaxic frame (David Kopf, Inc.); SurgiVet capnograph for monitoring the rat's physiological state; Mettler Analytic balance; Sutter P-97 pipette puller; WPI DB-S preamplifier and amplifier for recording field potentials from the rat cortex, along with assorted other minor equipment and surgical tools.

Benton 333 houses two vibration isolation tables with electromagnetic shielding. These are suitable for precision high magnification microscopy and for delicate electrophysiology experiments using animal preparations. This lab is also fully equipped with advanced apparatus and electronics for experimental electrophysiology. The laboratory also houses computer and office space used by Prof. Moss.

Benton 449 is the Daphnia laboratory, where infrared imaging studies of Daphnia swarming motion are performed. Analysis of these studies is performed using computers housed in Benton 449, Research 401, and Benton 333.

Machine and electronics shops. The physics department also has fully equipped electronics and machine shops with an electronics technician and a machinist. These facilities and personnel are available to the Center on a shared basis with the Department of Physics and Astronomy.

B. Facilities based in the Department of Biology:

Research Space. Two laboratories house research activities for the Center. These include rooms Research 237 (600 ft²) and Stadler 202 (450 ft²) for Dr. Wilkens. All laboratories have utilities for wet lab research, including chemical hoods, air, gas and vacuum supply. Research 237 is subdivided into functional spaces, a general laboratory plus two rooms for electrophysiological recording, a microscope room that can be darkened for fluorescent use, and a small office (60 ft²) for student or research associates (currently by Dr. Michael Hofmann). Stadler 202 is designed, in addition, for controlled behavioral experimentation and is divided into a central anteroom interconnected with four separate rooms, each with
independent floor drains, light timers and temperature control (heating and AC). These rooms were designed specifically for fish research and all paddlefish behavioral work is performed in Stadler 202. Additional space/facilities in biology include two aquarium rooms with independent recirculating filtration systems for maintaining paddlefish stocks, a student shop for fabrication of apparatus, and two darkrooms. Drs. Wilkens has separate office space of approximately 110 ft².

Equipment. All laboratories are well equipped with modern research equipment. Electrophysiological equipment for three complete research stations is present, including dissecting microscopes, vibration isolation tables, Faraday cages, amplifiers and signal conditioners, stimulators and signal generators, and computerized data acquisition and analysis systems. Desktop publishing hardware/software, in addition to computers, includes color and black & white printers and scanners, digital cameras and conventional photographic equipment. A wide range of video equipment is available including cameras, editing VCRs, infrared illuminators, monitors and tripods. Two histology setups are available which include fluorescent compound microscopes with cameras, tissue slicers, freezing microtome and associated smaller items.

Aquariums in Stadler 122 and Stadler 126 are used to maintain paddlefish for experimental research. Each room contains sinks with hot and cold water, conditioned well water on tap (dechlorinated for use with fish), and floor drains. Stadler 126 has 3 built-in concrete tanks with total capacity of 700 gallons, recirculating particulate and biological filters, and ultraviolet sterilizers. An additional rectangular fiberglass raceway with similar filtration and 650 gallon capacity has been installed in Stadler 126. Stadler 122 was recently converted for additional fish holding by installing a 700 gallon round fiberglass tank and associated filtration equipment.

C. Other University Resources

Library. The University of Missouri St. Louis library contains most of the relevant research journals and a reasonable selection of monographs. Interlibrary loan services provide for additional materials on a timely basis.

Animal Welfare Unit. UMSL maintains an Animal Welfare Unit on the 5th floor of Stadler Hall. AWU staff care for the paddlefish in the Stadler aquarium rooms, and the rats used in the imaging experiments before the animals are transferred to Research 404 for imaging. A veterinarian, who works jointly at Washington University and UMSL, is available for consultation as needed.

D. Required Changes or Additions to Center Resources.
As faculty are provided space by their respective departments, laboratory space is currently adequate. Additional laboratory and office space would be required for new graduate students or postdoctoral associates funded by future grants. Any new positions in the Center would be provided space according to current departmental policies for setting up new faculty.
Over the long term, it would be advantageous to have a central location for Center for Neurodynamics laboratories and faculty offices. However, since all the laboratories and
offices are housed in three adjoining buildings (Benton, Research, Stadler), Center members can communicate with each other easily under the current circumstances.

The two aquarium rooms are inadequate for our current research needs. Paddlefish are available for purchase only one time per year, in conjunction with spring spawning in aquaculture facilities. Thus, sufficient numbers of paddlefish must be obtained to last the full year and current holding facilities are overcrowded for more than six months of the year. This also exposes us to critical loss of animals in the event of accidents and/or disease. Additional holding tanks are necessary, as are separate tanks for isolating individual animals during experiments.

1.7 Personnel (2003-2008)

Faculty
- Curator’s Professor Frank Moss (Founding Director, Center for Neurodynamics)
- Professor Lon Wilkens (Founding Associate Director, Center for Neurodynamics)
- Assistant Professor Sonya Bahar (Director, Center for Neurodynamics, since March 2006)
- Research Assistant Professor Michael Hofmann
- Research Assistant Professor Vassiliy Tsytsarev

Postdoctoral Research Associates
- Boris Chagnaud
- Vassiliy Tsytsarev (now Research Assistant Professor)
- Alexander Scheuerlein

Graduate Students
- Jorge Brea (PhD in Physics, 2007)
- Daisuke Takeshita (MS in Physics, 2003; currently a PhD candidate)
- Roxana Contreras (currently PhD candidate)
- Nathan Dees (currently PhD candidate)
- Douglas Brumm (MS in Physics, 2007)
- Kaushalya Premachandra
- Oliver Weihberger (MS in Physics, 2005)
- Elizabeth Caspari (MS in Physics, 2003)
- Bryce Meyer (MS in Biology, 2006)

Undergraduate Students
- Keara Wright
- Oljimi (Jimi) Faminu (BS in Chemistry and Biochemistry, 2007)
- Douglas Brumm (now a graduate student, also listed above)
- Ricardo Garcia (BS in Physics, 2007)
- Cara Sweitzer (BS in Biology, 2008)
- Sally Breite (BS in Physics, 2003)
1.8 Contributions to Campus Identity

While the Center continues to make significant educational contributions to campus identity via its educational impact on graduate and undergraduate students, the Center’s most fundamental contribution to campus identity rests in its internationally recognized research program. Center members maintain active collaborations, writing both articles and grants, with scientists in the United States, Europe, and Asia (University of Bonn, Weill-Cornell Medical College of Cornell University, Sungkyunkwan University, South Korea, Washington University in St. Louis, and Saint Louis University, among others).

Center members have presented 50 talks and posters at meetings between 2003-2008, including 25 invited talks. The Center hosted an international conference in October 2004, celebrating Prof. Frank Moss’s 70th birthday. The Center also conceived of the idea and co-sponsored an international meeting on Electoreception and Hair Cell Biology held at the Max Plank Institute in Dresden, Germany. Center members have published 35 papers in peer-reviewed publications since 2003 (See Section 2.4 and Appendix A), as discussed in more detail below. All of these scientific contributions contribute to UMSL’s identity as an internationally-recognized research institution.

The Center’s early seminal papers in Nature continue to play an influential role in the nonlinear dynamics and neuroscience communities. The paper which sparked the creation of the Center (Douglass JK, Wilkens L, Panazelou E, Moss F. Noise enhancement of information-transfer in crayfish mechanoreceptors by stochastic resonance. Nature 365(6444):337-340, 1993) has now been cited\(^1\) a total of 560 times, with 177 citations since 2003.

A review article on stochastic resonance by the Center’s Founding Director Frank Moss (Wiesenfeld K, Moss F. Stochastic resonance and the benefits of noise – from ice ages to...

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\(^1\) All citation statistics are taken from the ISI Web of Knowledge (http://apps.isiknowledge.com/)
crayfish and SQUIDS. *Nature* 373(6509):33-36, 1995, has now been cited 701 times, with 233 citations since 2003.

Another *Nature* paper from the Center, the first demonstration of behavioral stochastic resonance (Russell DF, Wilkens L, Moss F. Use of behavioural stochastic resonance by paddlefish for feeding. *Nature* 402(6759):291-294, 1999) has been cited 141 times, including 87 citations since 2003.

The Center’s more recent work has also been noted in the scientific press within the past few years. Prof. Moss’s studies of *Daphnia* swarming were featured in APS News last year ([http://www.aps.org/publications/apsnews/200705/smartorganisms.cfm](http://www.aps.org/publications/apsnews/200705/smartorganisms.cfm)), as well as in the March 17, 2007 issue of *The New Scientist*. Moss was also interviewed for an article in *The New Scientist* titled “Lockstep neurons caught in the act”, which appeared on March 22, 2003. Undergraduate student Ricardo Garcia was interviewed about his studies of *Daphnia* motion during a press conference at the March 2007 APS meeting in Denver, doing a stellar job of stepping in at the last minute to field questions in place of Prof. Moss. Most recently, Prof. Moss was interviewed last month by science journalist Laura Spinney for a feature article on biological stochastic resonance to appear in the *New Scientist*.

Prof. Wilkens’ paddlefish research program has achieved rapid recognition within the well-established fish electrosensory discipline in the neurosciences, leading to invitations to contribute numerous summary chapters and reviews in monograph series and books (e.g., *Sensory Evolution on the Threshold*, 2008; *Bioscience*, 2007; *Handbook of Auditory Physiology*, 2005; *The Senses of Fish*, 2004; *Sensory Processing in Aquatic Environments*, 2003; see Publications list). Further, this corpus of work has been cited in sources varying widely, from articles in newspapers, conservation magazines (Nature Conservancy, Australian National Museum), broadcast media (BBC, Discovery Channel), to the *Weekly Reader*.

The Center has also contributed to UMSL’s identity by sending excellent “alumni” to various universities and research groups throughout the country and internationally. For example, Kevin Dolan (PhD, Physics) pursued postdoctoral work in the group of Prof. Peter Tass at the Research Centre Jülich in Germany, and now works for Philips. Gabor Balázsi (PhD, Physics) pursued postdoctoral research at Northwestern University and Boston University (with Jim Collins), and now has a faculty position at the M. D. Anderson Cancer Center in Texas. The Center’s most recent PhD graduate, Jorge Brea, is a postdoctoral researcher in the group of Nancy Kopell at Boston University.

Postdoctoral associates of the Center have also “graduated” to academic appointments at other institutions. Alexander Neiman (Moss) is currently an Associate Professor in the Department of Physics, Ohio University. Winfried Wojtenek (Wilkens) is assistant professor of neuroscience at the Universidad San Francisco de Quito in Ecuador where he is developing a new first-time discipline in the neurosciences for this country. He was recently featured as a Newsmaker in a recent edition (2007) of *Science*. 
The Center’s in vivo brain imaging studies were nationally recognized recently, when Dr. Bahar’s NSF CAREER grant received a Presidential Early Career Award for Scientists and Engineers (November 2007). This aspect of the Center’s research was recently recognized locally when the Saint Louis Academy of Science announced that Dr. Bahar will receive the Academy’s Innovation Award in the spring of 2008.

The Center’s frequent hosting of scientific guests further enhances the Center’s contributions to campus identity. This not only brings many guest speakers to the campus, but also allows the guests to take their “UMSL experience” back to their own home institutions. Since 2003, our scientific guests have included:

Michal Zochowski (University of Michigan), Rhonda Dzakpasu (University of Michigan), Alexandra Rodkina (University of the West Indies, Kingston, Jamaica), Renato Feres (Washington University), Yoram Rudy (Washington University), Lihong Wang (Washington University), Linda Larson-Prior (Washington University), Igor Efimov (Washington University), Hans Braun (University of Marburg, Germany), Karlheinz Voigt (University of Marburg, Germany), Christian Finke (University of Marburg, Germany), Robert Gilmore (Drexel University), Mike Shlesinger (Office of Naval Research), Bruno Eckhardt (Philips-Universität Marburg), Peter Jung (Ohio University), Plamen Ivanov (Boston University), Saw-Wai Hla (Ohio University), Epaminondas Rosa (Illinois State University), Ken Showalter (West Virginia University), Ai Nihongi (University of Wisconsin, Milwaukee), Dante Chialvo (Northwestern University), John Clark (Washington University), Mark Spano (Naval Surface Warfare Center), John Milton (University of Chicago / Claremont College), Steven Rothman (Washington University), Jack Hudson (University of Virginia), Alfred Hübler (University of Illinois at Urbana-Champaign), Minah Suh (Weill-Cornell Medical College of Cornell University), Hongtao Ma (Weill-Cornell Medical College of Cornell University), Vernon Towle (University of Chicago), Adi Bulsara (Space and Naval Warfare Systems Center, San Diego).

The coming months will see still more guests visiting the Center for Neurodynamics. In June, a distinguished Professor from the University of Bonn, Horst Bleckmann, will visit the Center to work on the electrosensory and mechanosensory lateral line of the paddlefish. At the same time, a postdoctoral associate, Venessa Kassing, will join the Wilkens/Hofmann laboratory to work on the anatomical pathways that connect the midbrain with hindbrain motor centers. We also expect a graduate student from Germany to apply for a PhD program here in St. Louis.

1.9 Relation with Academic Departments

The Center for Neurodynamics has close ties to both the Department of Physics and Astronomy and to the Department of Biology, since the Center’s faculty members (Bahar and Wilkens) have their tenure homes in those departments, respectively. Grant incentive funds are split between the Center and the respective departments. Center visitors often give colloquia in the Department of Physics and Astronomy or in the Department of
Biology. All the PhD students working in the Center for Neurodynamics are students in the Department of Physics and Astronomy.

One of the Center’s primary goals for the next five years is to strengthen ties with other Centers and Departments as well (e.g., the Center for Nanoscience, the College of Optometry, and the Department of Psychology). This is discussed in more detail in the Section 3 below.

1.10 Changes since 2003 Program Review

Since the 2003 Program Review, Dr. Sonya Bahar has joined the faculty of UMSL and the Center for Neurodynamics, becoming Director of the Center in 2006, after Prof. Frank Moss stepped down from the position. Two former productive members of the Center have relocated to Ohio University. Alexander Neiman accepted a tenure-track position in 2005 and David Russell transferred his NIH grant to collaborate with Dr. Neiman, moving in 2006. The Center has recruited two excellent Research Faculty members, Dr. Michael Hofmann and Dr. Vassiliy Tsytsarev. Professor Frank Moss has retired from his faculty position at UMSL as of December 2007, but continues to collaborate scientifically with members of the Center. The Center has also taken a major shift in primary sources of funding, with both Dr. Bahar and Drs. Wilkens and Hofmann receiving 5- and 3-year grants, respectively, from the National Science Foundation. The Center’s governance structure has changed, with the Director now reporting to the Vice Provost for Research rather than to the Dean of Arts and Sciences. The scientific focus of the Center has also expanded, as discussed elsewhere in this report.

A discussion of changes since the 2003 Program Review cannot end without a brief mention of the changes we anticipate before the 2013 review. As this report makes abundantly clear, Dr. Lon Wilkens, the Center’s Associate Director, has made, and continues to make, major contributions to the Center’s scientific productivity. Dr. Wilkens, however, is now eligible for retirement. With the current hiring freeze, it is not clear when he would be replaced. Moreover, it is not clear that a replacement position in the neurosciences would be made by the Department of Biology, regardless of the hiring freeze. This raises the possibility of a major “hole” in the Center. While this can be compensated for to some extent by additional collaborations on campus (see Section 3), this is an issue that will likely have to be addressed by the Center before its next program review.

2. Review and Assessment of the Center for Neurodynamics

2.1 Size, diversity and scholarship

A fundamental goal of the Center is to foster interdisciplinary scholarship. From that standpoint, the diversity of its membership (ranging from physicists to neurophysiologists) is at the heart of its strength. Center members meet at a weekly Friday lab meeting to exchange ideas. This diversity of ideas is absolutely at the heart of the Center’s mission.
The size of the Center is limited by available faculty lines at the University. Fully aware of this limitation, the Center has attempted, and continues to attempt, to make up for its small size in number of tenure-track or tenured faculty by recruiting a wide variety of excellent graduate students, postdoctoral scholars, and research faculty.

The scholarly contributions of Center members are absolutely fundamental to the Center’s goals. Recent contributions (since 2003) are outlined below.

2.2 Annual evaluation of scholarly and creative success.

The Center’s Board meets frequently, though informally, to discuss the Center’s scholarly and creative progress. The Center Director meets regularly with the Vice Provost for Research in order to discuss the Center’s activities and their relation to other research endeavors on the UMSL campus and within the St. Louis region.

2.3 Recruitment of personnel and fostering of scholarship.

When funding permits the hiring of new graduate research assistants or postdoctoral scholars, the Center actively recruits excellent students from the Department of Physics and Astronomy. International searches have been conducted for the hiring of postdoctoral scholars (such as Dr. Vassiliy Tsytsarev, now Research Assistant Professor). For the recruitment of new tenure-track or tenured faculty members, the Center’s Board will work with the Department of Physics and Astronomy and the Department of Biology to recruit new personnel for the Center, but such hires are dictated both by the budget of the College of Arts and Sciences, and by the need to meet other goals of the Departments.

Due to the research success of the Center as an interdisciplinary scholarly unit, a model for collaborative research now nearly essential in the sciences, it serves its home departments well providing an incentive for the retention of positions following retirements. With the minimum critical mass of active tenure-track faculty (2), maintaining the Center was seen as an asset for adding a position in Physics and Astronomy in 2004, as discussed earlier. Biology also stands to benefit, potentially, since Prof. Wilkens, Founding Associate Director, is “retirement eligible”.

Fostering of scholarship is the most fundamental goal of the Center for Neurodynamics. The Center’s faculty works closely with the graduate students in order to train them as independent scholars. Weekly lab meetings bring all members of the Center together for informal discussions, research updates, journal club meetings, and talks by invited guests. The Center’s Grant Incentive Fund is used to supplement Center members’ external funding when necessary. The different laboratories within the Center regularly share both equipment and expertise in order to optimize the Center’s ability to produce a high level of scientific scholarship.
2.4 Scholarly activities 2003-2008.

Since 2003, members of the Center for Neurodynamics have published 25 articles in peer-reviewed scientific journals, presented 25 invited talks at national or international conferences, made 27 contributed presentations (talks and posters) at scientific meetings, given 25 invited talks, organized 6 international conferences and workshops, organized three sessions at major scientific meetings, and served on four international scientific advisory committees. Center members currently have six journal articles in press, one conference proceedings paper in press, and three manuscripts submitted. A detailed listing of these scientific contributions appears in Appendix A (page 18).

2.5 Funding 2003-2008.

Total grant support for this period: $1,937,050 direct costs (F&A $555,613).

**PI: Bahar**

*Funding Agency / Grant Type:* NSF CAREER (PECASE)

*Grant Title:* CAREER: From Imaging Collective Dynamics in the Cortex to Teaching Interdisciplinary Science

*Start Date:* June 1, 2006

*Amount Requested:* $410,075 direct costs over 5 years (F&A $172,167)

*Status:* Funded (full amount)

**PI: Wilkens/Hofmann**

*Funding Agency / Grant Type:* NSF

*Grant Title:* Electrosensory processing in plankton capture by the paddlefish

*Start Date:* June 1, 2005

*Amount Requested:* $464,911 direct costs over 3 years (F&A $148,388)

*Status:* Funded (full amount)

**PI (Preceptor): Bahar; Awardee: Takeshita**

*Funding Agency / Grant Type:* Epilepsy Foundation of America Predoctoral Fellowship

*Grant Title:* Imaging and modeling the effect of inhibition in focal neocortical seizures

*Start Date:* January 1, 2008

*Amount Requested:* $20,000 (one year)

*Status:* Funded (full amount)

**PI: Bahar**

*Funding Agency / Grant Type:* Missouri Research Board

*Grant Title:* Imaging Seizures in the Neocortex

*Start Date:* June 1, 2005

*Amount Requested:* $50,000 (1 year)

*Status:* Funded ($30,000)

**PI: Wilkens**

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2 This count includes a peer-reviewed article which appeared online in Scholarpedia.
Funding Agency / Grant Type: UM Research Board
Grant Title: Electrosensory coding in the paddlefish brain
Start Date: 2005
Status: Funded ($39,441)

PI: Wilkens
Funding Agency / Grant Type: UMSL Research Award
Grant Title: Neural coding and spatial representation of weak electrical fields by the paddlefish
Start Date: 2005
Status: Funded ($11,938)

PI: Moss
Funding Agency: Office of Naval Research
Grant Title: Stochastic synchronization=pattern formation and information in biological systems.
Start Date: FY03
Amount Requested: $80,000
Status: Funded (full amount)

PI: Russell
Funding Agency: NSF Division of International Programs
Grant Title: US-Germany Cooperative Research: Stochastic Phase Resetting in Sensory Neurons.
Start Date: FY03
Amount Requested: $17,800
Status: Funded

PI: Russell/Neiman
Funding Agency: NIH
Grant Title: Stochastic Nonlinear Dynamics Of Sensory Nervous Systems.
Start Date: FY03
Amount Requested: $862,885 direct costs over 4 years (F&A $235,058)
Status: Funded

A total of 18 other grant proposals have been submitted by Center Members during this time, 5 of which are pending. If fully funded, these pending proposals will bring in a total of $1,535,201 in direct costs, and $551,509 in F&A. The pending proposals include:

PI: Hofmann/Wilkens
Funding Agency / Grant Type: National Science Foundation
Grant Title: Electrosensory processing in plankton capture by the paddlefish
Submission Date: 2008
Amount Requested: $683,077 direct costs over 3 years (F&A $224,991)
Status: Pending
2.6 Use of information technology.

The Center for Neurodynamics re-launched its website in the summer of 2007. The new site, at http://www.umsl.edu/~neurodyn/, provides up-to-date information on current research in the Center, as well as details of previous research projects, and links to the current work of Center alumni.

3. Five-Year Plan for the Center for Neurodynamics

1. Continue pursuing the scientific goals outlined in Section 1.5 above. Criteria for assessment: whether Center members publish significant scientific works in major peer-reviewed journals on these topics.

2. Educate excellent PhD scientists for interdisciplinary scientific careers. Criteria for assessment: number of PhD graduates between 2008-2013, and their career paths following graduation.
3. Expand external funding levels to provide for 4 graduate teaching assistants per year, and 4 research faculty members or postdoctoral scholars.

4. Launch a new experimental research program focusing on imaging activation of neural activity in the paddlefish. This new direction will combine the expertise of two main groups within the Center.

5. Expand the number of tenure-track faculty members in the Center. This goal is, of course, not entirely within the control of Center members, since it depends on the long-term hiring plans of the College and of their home departments. We note that the Department of Physics and Astronomy expressed a commitment to replacing the next faculty retirement with a theoretical biological physicist, depending on the availability of funds at the College level. (Faculty meeting, February 21, 2008).

6. Expand the interdisciplinary collaborations of Center members on the UMSL campus. We aim to submit collaborative grant proposals with colleagues in departments such as Psychology, Optometry, Nursing, and the Center for Nanoscience.

7. Expand Center membership to include a new category of “Associate Member”. These members would include UMSL faculty members in departments outside Physics & Astronomy or Biology. The Associate members would not contribute half of their GIF to the Center’s Grant Incentive Fund; rather, they would only contribute half of the returned GIF funds on grants written in collaboration with other Center members. This would provide an incentive for members of other departments to become involved in the Center, but without placing a significant financial burden on their home departments.

8. Establish a plan in conjunction with University Relations for raising funds the Center within the St. Louis area.
Appendix A

Scholarly Activities of Center for Neurodynamics Members 2003-2008

Submitted
Hofmann MH, Chagnaud B, Wilkens LA. An edge detection filter improves spatial resolution in the electrosensory system of the paddlefish. Submitted to *Science*.


**In Press**


Chagnaud BP, Wilkens LA, Hofmann MH. Receptive field organization of electrosensory neurons in the paddlefish (*Polyodon spathula*). *J. Physiol. (Paris)*.


Chagnaud BP, Bleckmann H, Hofmann MH. Lateral line nerve fibers are not sensitive to gross flow direction. *Zoology*.


**Published**

**2008**


**2007**


**2006**


**2005**


2004


Bloodworth, Donna M. MD; Nguyen, Ben N. MD; Garver, Wayne MS; Moss, Frank PhD; Pedroza, Claudia PhD; Tran, Thao MD; Chiou-Tan, Faye Y. MD, “Comparison of Stochastic vs. Conventional Transcutaneous Electrical Stimulation for Pain Modulation in Patients with Electromyographically Documented Radiculopathy”. *American Journal of Physical Medicine & Rehabilitation.* 83(8):584-591, 2004.

2003


**Publications in Conference Proceedings**


JL Mateos, AB Neiman, F Moss, J Fruend, L.Schimansky-Geier, and I Sokolov, "Walking on ratchets: a model of two Brownian motors with bistable coupling" in: *Noise in Complex


Book Chapters (refereed)


Invited conference talks (2003-2008)
Moss, F. “Turning angle distributions of foraging Daphnia and enhanced fitness.” Workshop on Nonlinear Collective Behavior: Networks, Swarming and Reaction Diffusion Dynamics. The Lorentz Center, University of Leiden, The Netherlands. 15 June 2007 – canceled due to health


Moss, F. “Optimal Foraging by Daphnia” (with Ricardo Garcia) Workshop on Active Motion and Swarms, 4-6 December 2006, Institute of Physics, Humboldt University, Berlin, Germany.

Moss, F. “Foraging for food in 2D: Characteristic swimming motions of Daphnia”, plenary talk, 5th Conference on Understanding Complex Systems, Department of Physics, University of Illinois at Urbana-Champaign, May 2005.


Moss, F. “It all started with Robert Brown”, Intern. School of Solid State Physics: ‘100 years of Brownian Motion’, Erice, Italy July 2005

Moss, F. “Are turning angles of feeding zooplankton distributed for survival?” Summer School: Design and Control of Self-Organization in Physical, Chemical and Biological Systems. International Center for Theoretical Physics, Trieste, Italy, August 2005.


Moss, F. “Pattern formations with a Zooplankton: Experiment and theory”, Conference on Pattern Formation in Physics and Biology, Kalvi Institute of Theoretical Physics, August 2003.


Moss, F. “Random walks with a zooplankton”, Understanding Complex Systems Symposium, University of Illinois at Urbana-Champaign, May 2003.


**Invited talks (non-conference)**

Moss, F. “Optimal Foraging by the Zooplankton Daphnia and Noise Enhanced Fitness”, colloquium Department of Physics University of Padova, Padova, Italy February 14, 2007

Moss, F. “Darwin, Creation and Intelligent Design: what it’s like in the U. S.” seminar, Department of Physics University of Padova, Padova, Italy February 14, 2007.


Moss, F. “Random Walks with a Zooplankton” Colloquium, Dept. Physics, University of Virginia, October 2004


Moss, F. “Swarming and Collective Motions of the Zooplankton Daphnia in Light fields”.Colloquium, Dept. Physics, Illinois State University, Normal, IL February 5, 2004

Moss, F. “Behavioral Stochastic Resonance” 1st Eberly College Distinguished Lecture, West Virginia University, Morgantown, April 22, 2004

Moss, F. “Complex motions of Self-Propelled Brownian Agents and Daphnia”, seminar, Complex Dynamics Group, Chemistry Department, West Virginia University, Morgantown, April 23, 2004

Moss, F. “Random Walks with a Zooplankton” Colloquium, Department of Physics, Ohio University, Athens, June 4, 2004.
Moss, F. “The physics of engagement: How to attract, retain, and engage students” New Faculty Teaching Scholars Program, Center for Teaching and Learning, UMSL, February 2003.

Moss, F. “Light mediated rectification in the crayfish caudal photoreceptor” Seminar, Department of Physics, Humboldt University of Berlin, Germany, March 2003.

Bahar, S. Synchronization, Epilepsy, and Brain Imaging. Department of Biomedical Engineering Colloquium, Washington University in St. Louis, October 30, 2007. Host: Dr. Yoram Rudy.

Bahar, S. Searching for the Elusive Initial Dip…and Other Things. Department of Physics Colloquium, University of Michigan, Ann Arbor MI, October 2, 2006. Host: Dr. Michal Zochowski.


Bahar, S. Searching for the Elusive Initial Dip. Department of Physics Colloquium, University of South Florida, Tampa, April 14, 2006. Host: Dr. Chun-Min Lo.


Bahar, S. Focal Seizures, Oxygenation and the Elusive Initial Dip. Computational Neuroscience Group, Department of Physics, Washington University, December 5, 2005. Host: Dr. Charles Anderson.


Bahar, S. Imaging Epileptic Seizures with the Intrinsic Optical Signal. Department of Physics, University of Missouri at Columbia, February 23, 2005. Host: Dr. Carsten Ullrich.

Bahar, S. Imaging Epileptic Seizures with the Intrinsic Optical Signal. Department of Physics, University of Missouri at Rolla, February 3, 2005. Hosts: Drs. G. Dan Waddill and Thomas Vojta.


**Contributed talks/posters/abstracts (2003-2008)**


Takeshita, D., Tsytsarev, V., Bahar, S. Phase synchronization analysis of voltage-sensitive dye imaging during drug-induced epileptic seizures. Talk to be presented at APS March Meeting, March 10, 2008, New Orleans, LA.


Sixteenth Annual Computational Neuroscience Meeting (CNS 2007), July 7-12, 2007, Toronto, Canada.


Conferences and workshops organized (2003-2008)


Moss, F. Co-organizer (with, H. A. Braun, University of Marburg, Germany and Erik Mosekilde, Danish Technical University, Lyngby, Denmark) International Workshop “From Complex Systems Theory to Clinical Neurology”, Max-Planck-Institute for the Physics of Complex Systems, Dresden, Germany, 4-8 June 2007.


**Conference sessions organized (2003-2008)**


**Service on International Conference Advisory Committees (2003-2008)**


Appendix B

CVs of Center for Neurodynamics Faculty 2003-2008

SONYA BAHAR, Ph.D.
bahars@umsl.edu

Center for Neurodynamics
Department of Physics and Astronomy
University of Missouri at St. Louis
One University Boulevard
St Louis MO 63121
Tel (314) 516-7150
Fax (314) 516-6152

ACADEMIC POSITIONS
Director, Center for Neurodynamics (March 2006 – present)
Assistant Professor of Biophysics, Department of Physics and Astronomy,
University of Missouri at St Louis (August 2004 – present)

POSTDOCTORAL EXPERIENCE

- May 2002 – June 2004, Postdoctoral Research Associate, Department of Neurological Surgery, Weill-Cornell Medical College of Cornell University, New York NY.
- July 2001 – May 2002, National Research Service Award Postdoctoral Fellow (NIH/NINDS), Center for Neurodynamics, University of Missouri at St Louis.
- December 1999 – July 2001, Postdoctoral Research Associate, Center for Neurodynamics, University of Missouri at St Louis.
- October 1997 - November 1999, Postdoctoral Research Associate, Department of Physics, Department of Cell Biology, and Center for Nonlinear and Complex Systems, Duke University, Durham NC.

EDUCATION

- M.S. in Biophysics, Department of Biophysics, University of Rochester, 1993.

PUBLICATIONS


PUBLISHED ABSTRACTS


CONTRIBUTIONS TO CONFERENCE PROCEEDINGS


BOOK CHAPTERS


BOOK REVIEWS


INVITED TALKS (CONFERENCE)


5. Phase Synchronization and Stochastic Resonance in the Crayfish Photoreceptor. Invited talk at “Stochastic Resonance: Applications in Medical and Brain Science”, September 2002 at the *International Institute for Advanced Scientific Studies (IIASS) “E. R. Caianiello”*, Vietri sul Mare, Salerno, Italy.


CONFERENCE PRESENTATIONS (CONTRIBUTED TALKS/ POSTERS)

1. Takeshita, D., Tsytsarev, V., Bahar, S. Phase synchronization analysis of voltage-sensitive dye imaging during drug-induced epileptic seizures. Talk to be presented at *APS March Meeting*, March 10, 2008, New Orleans, LA.


Neuroscience 2006 Annual Meeting, Atlanta GA, October 14-18, 2006. (Talk presented by V. Tsytsarev.)


**INVITED TALKS (NON-CONFERENCE)**


6. Focal Seizures, Oxygenation and the Elusive Initial Dip. **Computational Neuroscience Group, Department of Physics, Washington University,** December 5, 2005. Host: Dr. Charles Anderson.


8. Imaging Epileptic Seizures with the Intrinsic Optical Signal. **Department of Physics, University of Missouri at Columbia,** February 23, 2005. Host: Dr. Carsten Ullrich.

9. Imaging Epileptic Seizures with the Intrinsic Optical Signal. **Department of Physics, University of Missouri at Rolla,** February 3, 2005. Hosts: Drs. G. Dan Waddill and Thomas Vojta.


11. Imaging Seizures in the Rat Neocortex Using the Intrinsic Optical Signal. Department of Biology, **University of Missouri at St Louis,** September 14, 2004. Host: Dr. Wendy Olivas.

12. Phase Synchronization and Signal Rectification in the Crayfish Photoreceptor. **Applied Biodynamics Laboratory, Department of Bioengineering, Boston University,** February 2001. Host: Dr. James J. Collins.


14. Bistability and Hysteresis in Cardiac Muscle: *in vitro* and *in vivo*. **Department of Physiology, University of Marburg, Germany,** November 2000. Host: Dr. Hans A. Braun.

15. Phase Synchronization in the Crayfish Caudal Photoreceptor. **Institut für Theoretische Physik III, Justus-Liebig-Universität, Giessen, Germany,** November 2000. Hosts: Dr. Armin Bunde and Dr. Frank Moss.
16. Light Sensitivity, Mechanical Noise and Sensory Integration in the Crayfish Caudal Photoreceptor. **Department of Bioengineering, University of Illinois at Chicago.** October 2000. Host: Dr. John Hetling.

17. Bistability and Hysteresis in Cardiac Muscle: *in vitro* and *in vivo*. **School of Biomedical Engineering, Science and Health Systems, Drexel University.** May 2000. Host: Dr. Banu Onaral.

18. Bistability and Hysteresis in Cardiac Muscle: *in vitro* and *in vivo*. **Institut de génie biomédical and Centre de recherche de l'Hôpital du Sacré-Coeur, Faculté de Médecine, Université de Montréal.** January 2000. Host: Dr. Alain Vinet.


20. Bistability and Hysteresis in Frog Ventricle. **Center for Neurodynamics, University of Missouri at St. Louis,** April 1998. Host: Dr. Frank Moss.


**CONFERENCES ORGANIZED**

- **Noise and Complexity in Nonlinear Systems: A Conference Celebrating Frank Moss’s 70th Birthday.** Held at the University of Missouri at St Louis (Department of Physics and Astronomy), October 22-23, 2004. Co-organized with Dr. Gabor Balázsi.

**CONFERENCE SESSIONS ORGANIZED**


AWARDS

• Presidential Early Career Award for Scientists and Engineers (PECASE), 2007
• University of Missouri – St. Louis Office of Disability Access Services, Faculty Service Award, 2007
• NIH/NINDS National Research Service Award (Postdoctoral), 2001-2002.
• William Neuman Award, Department of Biophysics, University of Rochester, 1996.

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

• American Physical Society (Division of Biological Physics, Group on Statistical and Nonlinear Physics).
• American Association for the Advancement of Science (AAAS).
• National Center for Science Education (NCSE)
• Union of Concerned Scientists (UCS)

EDITORIAL SERVICE

• Editor of “The Biological Physicist”, the Newsletter of the Division of Biological Physics (http://www.aps.org/units/dbp), since 2000.
Curriculum Vitae

Lon A. Wilkens, Professor  
Center for Neurodynamics  
Department of Biology  
University of Missouri-St. Louis  
One University Boulevard  
St. Louis, Missouri 63121-4499  
(314) 516-6222; FAX 516-6233  
lon_wilkens@umsl.edu

Education

BA in Zoology, 1965, University of Kansas, Lawrence  
Ph.D. in Comparative Physiology, 1970, Florida State University, Tallahassee

Academic Appointments

Assistant Professor and Schwartz Lecturer in Biology, Bryn Mawr College, 1973-1975.  
Assistant Professor of Biology, University of Missouri-St. Louis, 1975-1979.  
Associate Professor of Biology, University of Missouri-St. Louis, 1979-1987.  
Associate Research Professor, Whitney Marine Laboratory, University of Florida, 1982.  
Professor of Biology, University of Missouri-St. Louis, 1988-present.  
Chairperson, Department of Biology, University of Missouri-St. Louis, 1989-1992.  
Associate Director, Center for Neurodynamics, University of Missouri-St. Louis, 1996-present.

Non Academic Appointments

Director, St. Louis Aquacenter Foundation for Education and Research, 1988-1993.

Teaching Experience

Introduction to Neuroscience  Invertebrate Biology  
Comparative Animal Physiology  Marine Science  
General Physiology  General Biology  
Invertebrate Neuroethology  Seminars, Topics in Biology

Research Experience

Independent Investigator, University of Washington, Friday Harbor Laboratories, 1972.  CNS control of respiration and heart rate in decapod crustaceans.  
Independent Investigator, Bermuda Biological Station, Bermuda, 1976.  Electrophysiology of the optic lobes of the scallop.

Independent Investigator, Bermuda Biological Station, Bermuda, 1979. Starfish-mediated escape in scallops.


**Teaching Grants**


**Research Grants**


Co-principal Investigator with Dr. B. W. Ache: NSF-Bermuda Biological Station Umbrella Grant, "Visual Integration in the Scallop CNS," 1976. $1,600.


Honors

NIH Predoctoral Fellow, Florida State University, 1968-70.
Grass Fellow in Neurophysiology, Marine Biological Laboratory, 1973
NIH Postdoctoral Fellow, University of Texas, Austin, 1970-73.
UMSL Chancellor’s Award for Excellence in Research, 2000.

Graduate Students

Craig Gurgens: Master of Science, 1996. University of Missouri-St. Louis
Derek Hildreth: Master of Science, 2003. University of Missouri-St. Louis
Bryce Meyer: Master of Science, 2006. University of Missouri-St. Louis

Laboratory Postdoctoral and Visiting Scientists

Tateo Shimozawa (VS), Hokkaido University, 1989.
Barbara Schmitz (VS), Universität Konstanz, 1996.
Michael Hofmann (VS), Universität Bonn, 1999-present.
Boris Chagnaud (VS), Universität Bonn, 2007.

Memberships

American Association for the Advancement of Science, since 1973.
American Microscopical Society, since 1996.
International Society for Neuroethology, since 1997.
Marine Biological Laboratory, Life Member.
Midwest Neurobiologists, since 1977.
Tallahassee, Sopchoppy and Gulf Coast Marine Biological Association, since 1968.

Professional Activities

Publications (refereed)


Wojtenek, W., Pei, X. and Wilkens, L.A. Paddlefish strike at artificial dipoles simulating the weak electric fields of planktonic prey. J. Exp. Biol. 204, 1391-1399.


Wilkens, L.A. and Moss, F. Mechanoreceptors and Stochastic Resonance. *Scholarpedia*

**Manuscripts in Press (accepted)**

Chagnaud BP, Wilkens LA, Hofmann MH. Receptive field organization of electrosensory neurons in the paddlefish (*Polyodon spathula*). *J. Physiol. (Paris).*

Manuscripts Submitted

Manuscripts in Preparation
Hofmann, M.H., Wassoer, T. and Wilkens, L.A. Ascending electrosensory pathways to multiple targets in di- and mesencephalon in the paddlerfish (*Polyodon spathula*).

Abstracts from Presentations

1992


Douglass, J.K., Moss, F. and Wilkens, L.A. Crayfish filiform hair mechanoreceptors: a simple neuronal system for investigating stochastic resonance. NATO Advanced Research Workshop, San Diego, CA.

1993


Douglass, J.K., Wilkens, L.A. and Moss, F. Stochastic resonance in crayfish hydrodynamic receptors stimulated with noise. ICNF Conference, St. Louis, MO.


1994


1995


1996


1997


1998


Wojtenek, W. and Wilkens, L.A. Detection of artificial sinusoidal electrical signals by the paddlefish, *Polyodon spathula*. 5th Int. Congress of Neuroethology, No. 345. La Jolla, CA.

1999


Wojtenek, W., Neiman, A., Moss, F. and Wilkens, L.A. Primary afferent neurons of the electrosensory system of paddlefish respond to the electrical signal of paddlefish moving prey. Amer. Physics Soc. 18, 6.

Wilkens, L.A. The rostral electric sense of the paddlefish: design of a passive system for detection and capture of zooplankton prey. Neurobiology of Electrosensory Organisms, 4, 27.


Vita

Frank Edward Moss

Date and place of Birth: February 10, 1934, Paris Illinois

College and University Degrees:

<table>
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<tr>
<th>Institution</th>
<th>Degree</th>
<th>Field</th>
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<tr>
<td>University of Virginia</td>
<td>B.E.</td>
<td>Electrical Engineering</td>
<td>1956</td>
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<tr>
<td>University of Virginia</td>
<td>M.N.E.</td>
<td>Nuclear Engineering</td>
<td>1961</td>
</tr>
<tr>
<td>University of Virginia</td>
<td>Ph.D.</td>
<td>Physics</td>
<td>1964</td>
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Academic Experience- recent:

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<th>Institution</th>
<th>Rank</th>
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<tr>
<td>Research Laboratories</td>
<td>Associate Research Engineer</td>
<td>1956-61</td>
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<tr>
<td>for the Engineering Sciences,</td>
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<tr>
<td>University of Virginia</td>
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<tr>
<td>Department of Physics,</td>
<td>Research Associate</td>
<td>1964-65</td>
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<tr>
<td>University of Virginia</td>
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<tr>
<td>Rome, Italy</td>
<td>Guest Researcher</td>
<td>1965-67</td>
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<tr>
<td>Institute of Physics,</td>
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<tr>
<td>University of Rome,</td>
<td>NSF Postdoctoral Fellow</td>
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<tr>
<td>Rome, Italy</td>
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<tr>
<td>Research Laboratories</td>
<td>Senior Scientist</td>
<td>1967-71</td>
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<tr>
<td>University of Virginia</td>
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<tr>
<td>Department of Aerospace Engineering</td>
<td>Lecturer</td>
<td>1968-71</td>
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<tr>
<td>University of Virginia</td>
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<tr>
<td>Department of Physics,</td>
<td>Associate Professor of Physics</td>
<td>1971-76</td>
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<tr>
<td>University of Missouri,</td>
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<td>St. Louis, Missouri</td>
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<tr>
<td>Department of Physics,</td>
<td>Professor of Physics</td>
<td>1976-present</td>
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<tr>
<td>University of Missouri,</td>
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<tr>
<td>St. Louis, Missouri</td>
<td>Professor of Physics and Biology</td>
<td>1991-present</td>
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<td>Curators’ Professor</td>
<td>2000-present</td>
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</table>
Center for Neurodynamics  Director    1996-2006
University of Missouri,
St. Louis, Missouri

Visiting Positions:

Department of Physics,
University of Exeter,

Department of Physics,
University of Lancaster,
England Visiting Professor  5/1979 - 8/1979

Department of Physics,
University of Lancaster,

Service de Chimie Physique
Université Libre de Bruxelles
Brussels, Belgium Visiting Professor  9/1988 - 12/1988

Institut für Mathematik
Universität Augsburg
Augsburg, Germany Visiting Professor  6/1990 - 8/1990

Centre de Recherches Mathematiques
Universite de Montréal Visiting Professor & Member, Central
Montréal, Canada Organizing Group: Special Semester on
Spatial & Temporal Dynamics  9/1993 - 12/1993

Fellowships and Honors:


Special Physics Fellow, University of Virginia, Dept. of Physics, 1963-64.

National Science Foundation Postdoctoral Fellow, 1965-66.

Senior Visiting Fellowship, (British) Science Research Council, 1979-80.

Senior Visiting Fellowship, (British) Science Research Council, 1986-87.

Chancellor's Award for Achievement in Research and Creativity, 1988
Albert Leimer Visiting Professorship, University of Augsburg, Germany, summer, 1990

NATO Senior Visiting Fellowship, Italian National Research Council, Institute of Biophysics, Pisa, Italy, 9/1993 - 11/1993

Lecturer, Université de Montréal, Special Semester on Spatial and Temporal Dynamics. 9/1994 - 12/1994

President's Award for Research and Creativity, University of Missouri System, 1994

Elected to Fellowship in the American Physical Society, 1996
Citation: “For elucidating the structure of turbulent superfluid helium and for the discovery of stochastic resonance in sensory biology.”

Peter H. Raven Lifetime Award (for service and accomplishments in science), 1999, Awarded by the Academy of Science of St. Louis.

Elected to Fellowship in the Academy of Science of St. Louis, 1999.

Senior Humboldt Prize for study and research in Germany, 1999.

Named “Outstanding Referee” the Editors of the Journals of the American Physical Society, 2008.

Editorial:


Books edited:

1. Noise in Nonlinear Dynamical Systems:
   Vol. I Theory of Continuous Fokker-Planck Systems
   Vol. II Theory of Noise Induced Processes in Special Applications
   Vol. III Experiments and Simulations
   Senior Editor: Frank Moss (co-edited with P.V.E. McClintock)

2. Proceedings of the Conference on Noise and Chaos in Nonlinear Dynamical Systems
   Turin, Italy; March 1989
   Senior Editor: Frank Moss (co-edited with L. Lugiato and W. Schleich)

*External Appointments:*

Associate, Center of Excellence for Trauma Rehabilitation Research
Dr. Faye Chiou-Tan, MD, Director
Baylor College of Medicine
Houston, TX 77004......................................................2001 - present

*Editorships - Journals:*

2. Associate Editor, *Chaos*, 1 November 1997 - present

*Referee - Journals:*

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<td>Comp. Neural Systems</td>
<td>Biological Psychiatry</td>
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<td>Psychology and Behavior</td>
<td>Journal of Comparative Physiology A</td>
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<td>International Journal of Bifurcation &amp; Chaos</td>
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<td>Europhysics Letters</td>
<td>Nano Letters</td>
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*Referee – Research Proposals:*

National Science Foundation North Atlantic Treaty Organization
Italian National Research Council The Fetzer Institute Department of Energy
Natural Sciences and Engineering Research Council of Canada Keck Foundation
Petroleum Research Foundation The Royal Society (London) PLoS Biology

*Conference and Symposium Organization:*

59
Director: NATO Advanced Research Workshop on Noise and Chaos in Nonlinear Dynamical Systems, Turin, Italy, March 7 - 11, 1989. (Co-organizers: L. A. Lugiato, Polytechnic Institute of Turin; W. Schleich, Max-Planck Institute for Quantum Optics)

Member, Scientific Advisory Committee: Conference on Nonlinear Dynamics of Optical Systems, organized by: N. B. Abraham, E. Garmire and P. Mandel; Sponsored by the Optical Society of America; June 1990.


Co-chair: Section on Chaos in Biology and Medicine, SPIE Annual Meeting, Program on Exploiting Chaos and Nonlinearities, San Diego, CA, June 1993 (with Ditto, Bulsara, Spano, Garfinkel)

Organizer: Symposium on Stochastic Resonance and Noise Induced Bifurcations in Biological Systems, Division of Biological Physics, American Physical Society, Seattle WA, March 1993.

Director: Conference on Fluctuations in Nonlinear Systems in Physics and Biology, Okawville, Illinois, August 21-24, 1993

Co-organizer, Symposium on Noise and Information Transmission in Biological Systems, Biophysical Society, annual meeting, New Orleans, March 1994. (with D. Chialvo)

Co-organizer: Chaos Control in Hearts and Brains, Institute for Biophysics, Italian National Research Council, Pisa, Italy June 20-23, 1995 (with Ditto, Spano, Petracchi, Chillemi)

Co-organizer: Fluctuations in Biology, Beckman Institute, Univ. of Illinois at Urbana, St. Louis, MO, March 22-26, 1996 (with Jung and Anastasio)

Organizer: Symposium on Stochastic Resonance, Division of Biological Physics, American Physical Society, St. Louis, MO, March 1996.

Honorary Chair, International Conference on Nonlinear Dynamics and Chaos, Saratov, Russia, July 7-14, 1996

Organizer: Tutorials on Stochastic Resonance, Division of Biological Physics, American Physical Society, Kansas City, MO, March 1997.
Organizer: Symposium on Noisy, Neural Encoding: Determinism and Noise, Division of Biological Physics, American Physical Society, Los Angeles, CA, March 1998.

Organizer: Focus session on Noisy, Subthreshold Oscillations in Neuronal Systems, Division of Biological Physics, American Physical Society, Atlanta, GA March 1999.


Co-Organizer: Symposium on Noise and Synchronization in Biological and Medical Systems, Division of Biological Physics, American Physical Society, Minneapolis, MN, March 2000. (with Juergen Kurths, Potsdam University)

Organizer: Symposium on Neurons and Cells on Chips and Microsurfaces, Division of Biological Physics, American Physical Society, Seattle, WA, March 2001.


Co-organizer (with Peter Tass – Juelich) Focus Session: Dynamical Modeling: Molecular Through Behavioral Studies, American Physical Society, Division of Biological Physics, March 2002.

Organizer: Workshop on Biological Oscillators. UMSL – Center for Neurodynamics, Nov. 2002.

Co-organizer: Workshop on Electroreceptors, Oscillators and Hair Cells. Max-Planck Institute for the Physics of Complex Systems, Dresden Germany, 17 21 May 2004


Co-Chair (with Dr. Sergey Bezrukov and Dr. Hans Frauenfelder) SPIE International Symposium on Fluctuations and Noise (FN-01), Santa Fe, NM June 2003.


Co-organizer (with, H. A. Braun, University of Marburg, Germany and Erik Mosekilde, Danish Technical University, Lyngby, Denmark) International Workshop “From Complex


National Offices in Professional Societies:

Delegate at large: 1994-1996; Division of Biological Physics, American Physical Society.

Chair elect and Tutorials Chair: 1996-1997; Division of Biological Physics, American Physical Society.

Vice Chair and Program Chair: 1997-1998; Division of Biological Physics, American Physical Society.

Chair: 1998-1999; Division of Biological Physics, American Physical Society.

International Offices:

Scientific Advisory Board, AGORA for Biosystems, Sigtuna, Sweden, June 1998 - present

Panel Membership:


Patents disclosed:


2. F. Moss and E. Simonotto, "Technique for quantitatively measuring the human ability to distinguish and interpret fine detail in a randomly contaminated time varying visual scene." Disclosed July 1996 at UM-St. Louis.

Research Publications and Presentations:

Author of over 225 research publications in refereed journals. List available upon request.

Presenter of over 280 lectures at conferences and institutes. List available upon request.

Editorial Commentary on my work or Commentary wherein I was interviewed and quoted on my own work or the work of others:


19. James Glanz, "Mastering the nonlinear brain" *Science* 277, 1758-1760 (September 19, 1997)


27. Adam Marcus, "Clever paddlefish may hold key to electronic 'nerves'", *Electronic Engineering Times*, November 9, 1998


33. Christian Speicher, “Rauschen schärft die Sinne” (in German) *Neue Zuercher Zeitung*, 12 November 2000, Zurich, Switzerland


**Editorial Commentary on Contemporary Work (invited by the editors):**


7. F. Moss, "Stochastic resonance at the molecular level.", *Biophys. J.* 73, ?? (1997)


Curriculum vitae

Michael H. Hofmann

Education
1967-1971 Grundschule GIII Hildesheim
1971-1980 Gymnasium Andreanum Hildesheim
1980-1982 Military service German Army
1982-1989 Biology studies, University of Goettingen, Germany
1989 Diplom in Biology
1989-1992 Ph.D. student at University of Goettingen, Germany
1992 Ph.D. in Zoology from the University of Goettingen
2000 Habilitation at the University of Bonn, Germany
2004 Promotion to Hochschuldozent

Research training and position
1984-1992 Graduate student in the lab of Prof. D.L. Meyer, Center of Anatomy, University of Goettingen, Germany.
1987 One month predoctoral fellow with Prof. S.O.E. Ebbesson at the University of Fairbanks, Alaska
1987-1993 Part time hard- and software developer at HEEDFELD Electronics, Bielefeld, Germany.
1988-1992 Tutor of Physiology and Psychophysics at the University of Goettingen
1988 Predoctoral fellow in the lab of Prof. T.H. Bullock at the University of California, San Diego for three months.
1989 Predoctoral fellow in the lab of Prof. T.H. Bullock at the University of California, San Diego for three months.
1990 Predoctoral fellow in the lab of Prof. T.H. Bullock at the University of California, San Diego for three months.
1991 Three months predoctoral fellow with Prof. S.O.E. Ebbesson at the University of Fairbanks, Alaska
1993-1995 Postdoctoral fellow in the lab of Prof. T.H. Bullock and Prof. R.G. Northcutt at the University of California, San Diego and Scripps Institution of Oceanography, La Jolla, CA, USA.
1995-2000 Postdoc position at the University of Bonn, Germany, with Prof. Horst Bleckmann.
2001-2004 Assistant Professor at the University of Bonn, Institute of Zoology, Germany
2004-2006 Associate Professor, at the University of Bonn, Germany
2006-Present Research Assistant Professor, University of Missouri, St. Louis.
Grants

1993-1995 Postdoctoral fellowship from the German Science Foundation (September 1st to November 30th) Grass Fellowship at Friday Harbor, University of Washington, Washington State, USA.
2002 Grant from the University of Bonn for a research trip to Brisbane, Australia
2003 DFG grant “The electrosensory system of the paddlefish”
2005 Co-PI on a grant from the NSF: “Physiology of the electrosensory system in the paddlefish” to Lon Wilkens, UMSL
2008 (pending) PI on a grant from the NSF: “Electrosensory processing in plankton capture by the paddlefish”

Teaching experience

2008- Lecture “Vertebrate Physiology”
2004-2006 Lecture “Biology of Fishes”
2000-2006 Courses of neuroanatomical techniques (4 weeks full-time block course each year)
1995-2002 Courses of neurophysiological techniques (4 weeks full-time block course each year)
1995-2000 Courses in Animal Behavior (4 weeks full-time block course each year)
1995-1997 Seminar: Physiology of Sensory and Motor Systems in the Vertebrate Brain (2 h per week)
1998-2002 Sensory physiology for undergraduates (4 h per week)
2000-2002 Anatomy and Histology of animals (4 h per week)
1991-1992 Course in neuroanatomy of the human brain for medical students
1988-1992 Courses in Physiology and Psychophysics at the University of Göttingen, Germany

Conferences

2000 Co-Organizer of the Congress of the German Zoology Society
2001 Co-Organizer of the 6th International Congress of Neuroethology in Bonn, Germany
2004 Co-Organizer of the Workshop of on Hair Cells and Electrosensation at the MPI Dresden

List of Publications

Papers submitted:

Hofmann MH, Chagnaud BP, Wilkens LA. An edge detection filter improves spatial resolution in the electrosensory system of the Paddlefish. (submitted to Science).

**Papers in press:**


**Papers published:**


Abstracts:


73


Curriculum Vitae

January, 2008

VASSILIY TSYTSAREV

Date and place of birth: 06 / 02 / 1969, St. Petersburg, Russia

Citizenship: Russia

Professional Title and Institutional Affiliation:
Research Assistant Professor, Center for Neurodynamics, Department of Physics and Astronomy
University of Missouri at St. Louis

Address: One University Boulevard, St. Louis MO 63121
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Home address: 7512 Cromwell Dr., apt. 5, MO 63105, Clayton
Home phone: +1 (314) 862 – 7966

Education: 1998 - Ph.D. in Neuroscience, St. Petersburg State University St. Petersburg, Russia

Personal Information: Married, two daughters

Education
1993 – M.S. in Biology, St. Petersburg State University, Russia
1998 – PhD in Neuroscience, St. Petersburg State University, Russia

Main scientific interests
Brain Optical Imaging, Epilepsy, Functional Brain Mapping, Neural Integration, Neurocomputation

Reviewing
From 2007, Reviewer for NeuroImage

Special Awards:
June 3, 2005 – nominated as an International Scientist of the year by International Biographical Center of Cambridge, UK

Professional Experience:
1993-1996 – Post-Graduate student, The Animals and Human Physiology Dept. St. Petersburg State University, St. Petersburg, Russia
1996 – International Ph.D.-student-researcher Rudolf Magnus Institute for Neuroscience, University of Utrecht, Utrecht, the Netherlands

1997 – Ph.D. in Neuroscience, St. Petersburg State University, St. Petersburg, Russia

1998 – International Training Center for the International Mobility Organization Medical Faculty of University of Oulu, Oulu, Finland

1998 – Postdoctoral researcher Laboratory for Visual Neurocomputing Brain Science Institute of RIKEN, Japan

2003 – 2005 – Visiting Scientist, Brain Science Institute of RIKEN, Japan

2005 (June-August) – Laboratory of Living Cells Imaging Helsinki Neuroscience Center, Helsinki, Finland

2003 - 2005 – Fellowship of the Japanese Society Promotion of Science (JSPS), Human Brain Research Center, Kyoto University, Kyoto, Japan

2005 – Postdoctoral Research Associate, Center for Neurodynamics, Department of Physics and Astronomy University of Missouri at St. Louis

2006 – Research Assistant Professor, Center for Neurodynamics, Department of Physics and Astronomy, University of Missouri at St. Louis

Fellowships

1991 – Elba International Neuroscience Program, Summer School, Italy

1994 – Grant of the Biological Program of the Physiological Institute, St. Petersburg State University, St. Petersburg, Russia


1995 – Elba International Neuroscience Program, Summer School Italy

1995 – Fellowship of the Center of Galician Studies (Spain)

1998 – Fellowship of the Center of International Mobility Organization (CIMO), Finland

2003- 2005: Japanese Society Promotion of Science (JSPS) Two Years Fellowship and Special Research Grant

List of Publications

Articles


8. Intrinsic optical signals from rat primary auditory cortex in response to sound stimuli presented to contralateral, ipsilateral and bilateral ears. Tsytsarev V, Tanaka S. Neuroreport 2002 Sep 16 13:13


10. Ignashchenkova AY, Tsytsarev VY, Lenkov DN Study of peripheral and central inputs into the mesial cortex in adult and developing rats. European Journal of Neuroscience 10: 3132 Suppl. 10 1998


Abstracts


8. Optical Imaging of the differential responses to contra-, ipsi-, and bilateral sound stimulation from the rat auditory cortex Tsytasre V. and Tanaka S. Laboratory for Visual Neurocomputing, RIKEN Brain Science Institute, FAONS Symposium 2000 and 20th Scientific Meeting of The Hong Kong Society of Neurosciences December 7 - 10, 2000


Invited Talks

07. 25. 2007 Department of Neurological Surgery Weill Medical College Cornell University. In Vivo Voltage –Sensitive Dye Optical Imaging of the Somatosensory Cortex

01. 30. 2007 Dept. of Biomedical Engineering, Washington University at St. Louis., USA In Vivo Optical Imaging of the Auditory and Somatosensory Cortex
07. 07. 2006 Department of Radiology, Washington University School of Medicine. In Vivo Optical Imaging of the Epileptic Seizures

02. 22. 2005 Brookhaven National Laboratory, New-York, USA. In Vivo Intrinsic and Voltage- Sensitive Dye Optical Imaging of the Auditory Cortex


02. 15. 2005 Vanderbilt University, Nashville, USA. Intrinsic and Voltage- Sensitive Dye Optical Imaging of the Auditory Cortex in Acute and Chronic Experiments.

04. 17. 2004 University of Bradford, School of Pharmacy, Bradford, UK. Functional Mapping of Cat Auditory Cortex by Intrinsic Optical Imaging.

11. 09. 2004 Korean Advanced Institute of Science and Technology (KAIST), Dojon, South Korea. Intrinsic and Extrinsic Optical Imaging for Functional Brain Mapping Research In Vivo

02. 24. 2004 School of Physics Seoul National University, Seoul, South Korea. Intrinsic and Extrinsic Optical Imaging for Functional Brain Mapping Research In Vivo

11. 25. 2003 Auditory Research Forum of Japan, Komatsu, Japan. Optical imaging of the differential responses to contra-, ipsi, and bilateral sound stimulation from the rat auditory cortex

Series of lectures

1994: Teaching Assistant of the student practical works at the Marine Biological Station, White Sea, St. Petersburg State University, Russia
1995: Tutor of the practical works on General Physiology St. Petersburg State University, St. Petersburg, Russia
1997: Introduction to the Electrophysiology of the Brain Lectures and seminars St. Petersburg State University, St Petersburg, Russia
2003 – 2004: Periodical lectures concerning in vivo optical imaging, Kyoto University School of Medicine, Kyoto, Japan
2006 - 2007: Biophysics of Imaging (PHYS 5400) Course for undergraduate and graduate students included few labs and seminar, 4 credit hours; University of Missouri at St. Louis

Graduate Advising

2007: Member, Master’s Thesis Committee (Douglas Brumm, Dept. of Physics & Astronomy, University of Missouri at St. Louis, defense scheduled for July 2007)

Scientific Associations
2000-- Society for Neuroscience (SFN) of the USA
2000-- Japanese Neuroscience Society
2000-- International Brain Research Organization (IBRO)
1993-- Member of the Russian Natural Sciences Society

**Methods**

Surgery operation of animals for acute and chronic electrophysiological and optical imaging experiments
Multiunit Recording
Intracortical Microstimulation (ICMS)
Optical Imaging of Intrinsic Signal (OIIS) by Imager 2001, Capos, Metamorph
Experiments with TDT Auditory Neurophysiology Workstation
Data Analysis by Interactive Data Language (IDL)
Experience in Auditory Research
Voltage Sensitive Dye in vitro and in vivo
Calcium Sensitive Dye in vitro and in vivo
Confocal microscopy
Human fMRI experimental design