

Vladislav Y. Toronov

Curriculum Vitae

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University of Illinois at Urbana-Champaign
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Work Authorization: Authorized to work in the US for any employer

Education:

Ph.D.: Physical and Mathematical Sci. (Laser Physics and Optics), Saratov State University (SSU), Saratov, Russia, 1992.

M.S.: Electrical Engineering, Moscow Engineering-Physics Institute, Moscow, USSR, 1986.

fMRI course, Medical College of Wisconsin, Milwaukee, WI, 2000

ICE/IDEA MRI pulse sequence programming course, Siemens Training and Development Center, Cary, NC, 2003

Skills:

Near-infrared tissue optics, oximetry, and image reconstruction

Magnetic Resonance Imaging: physics and physiology, statistical analysis of fMRI

Optics and Lasers

Biophysics of brain function

Applied Mathematics, Numerical Analysis of experimental data

Programming (MATLAB, C, FORTRAN)

Research areas:

Optical Imaging of Biological Tissues, Physics and Biochemistry of Functional Magnetic Resonance Imaging, Biophysics and Biochemistry of Brain Function

Teaching experience:

Lectureships: Mathematical Modeling in Physics; Laser Physics; *Seminars and Labs:* Optics, Atomic Physics, and Computational Physics; *advising student research*

Employment and experience:

- Since 2003: Senior Research Scientist, Biomedical Imaging Center, Beckman Institute for Advanced Life Science and Technology, University of Illinois at Urbana-Champaign. Co-Principal Investigator on the R01 NIH grant “Study of Cerebral Hemodynamics By Simultaneous Functional MRI and Near Infrared Spectroscopy”.
- 2000 – 2003: Postdoctoral Research Scientist, Beckman Institute for Advanced Life Science and Technology, University of Illinois at Urbana-Champaign. Simultaneous Functional Magnetic Resonance and Optical Imaging of Human Brain, Biomedical Signal Processing. Experience with Siemens Allegra 3T and GE Signa 1.5 T MRI scanners.
- 1997 - 2000: Visiting Scientist, Department of Physics, University of Illinois at Urbana-Champaign. Developing mathematical algorithms for signal analysis and infrared frequency-domain instrumentation for the non-invasive monitoring of processes in the human body; experimental non-invasive studies of brain hemodynamics. Experience with ISS tissue oximeters.
- 1992-1996: Research Assistant Professor, SSU, Saratov. Research: analytical and numerical investigation of nonlinear dynamics in mathematical models of lasers; theoretical study of topological effects in coherent light-matter interactions. Teaching different courses in physics and Applied Mathematics.
- 1989-1992: Ph. D. student, SSU, Saratov. Development of laser models and mathematical investigation of nonlinear dynamics in lasers. Analytical studies of partial and ordinary differential equations: multiple scale analysis, linear stability analysis, etc. Numerical investigations of bifurcations, routes to chaos and noise influence on the dynamics of dissipative systems. Advisors: Prof. A.N.Oraevsky (Lebedev Physics Institute, Moscow), Prof. V.V. Tuchin (SSU, Saratov).
- 1987-1988: Lomonosov State Univ., Moscow, Postgraduate Student. Study at Postgraduate Courses on theoretical and laser physics. Research in laser physics with Lebedev Physics Institute, Moscow. Advisor: Prof. A.N.Oraevsky.
- 1983-1986: Student of Moscow Engineering Physics Institute, Department of Experimental and Theoretical Physics. Research Assistant at Lebedev Physics Institute, Moscow. Theoretical research on chaos in optical systems, computer simulations. Advisors: Profs. A.N. Oraevsky and V.S. Anishchenko 1980-1983 Student of SSU, Saratov, Department of Physics. Advisor: Prof. V.S. Anishchenko.

Grants, Awards, and Contracts:

- 1992. Honor Personal Grant of International Science Foundation
- 1993. Honor Personal Grant of Sloan Foundation awarded by American Physical Society
- 2002. Functional Near Infrared Imaging System: subcontract with a small business company ISS, Champaign, IL on the SBIR NIH grant (co-PI)
- 2003. Study of Cerebral Hemodynamics By Simultaneous Functional MRI and Near Infrared Spectroscopy, NIH (Co-PI)

Professional Activities:

Member of the *International Society for Optical Engineers (SPIE)*
Member of the *Optical Society of America*
Member of the *Biophysical Society*

Scientific manuscript reviewer for: *Physical Review E*, *Physical Review Letters*, *Journal of Biomedical Optics*, *Applied Optics*, *Physics in Medicine and Biology (UK)*, *Ivestiya VUZ. Applied Nonlinear Dynamics (Russia)*, and *Optics Communications*.

Presentations at scientific meetings:

- 2003: 11th Scientific Meeting and Exhibition of the International Society for Magnetic Resonance in Medicine, Toronto, Canada, "Direct measurement of functional cerebral hemodynamic changes in humans and their influence on the BOLD signal"

SPIE Saratov Fall Meeting, Saratov, Russia, "Optimization of the Phase and Modulation Depth Signal-to-Noise ratio for Near-Infrared Spectroscopy of the Biological Tissue"
- 2002: SPIE International School for Young Scientists and Students on Optics, Laser Physics and Biophysics, Saratov, Russia: Toronov, V., A. Webb, J. H. Choi, M. Wolf, E. Gratton and D. Hueber, "Study of the fMRI blood oxygen level dependent effect by near-infrared spectroscopy" – **Invited**
- 2002: OSA Biomedical Topical Meetings and Exhibit, Miami Beach, USA: Choi J.H., M. Wolf, U. Wolf, C. Polzonetti, V. Toronov, D. Hueber, L. Safonova, A. Michalos, E. Gratton. "Absolute measurement of optical properties of adult human brain"

Wolf M., Wolf U., Choi J.H., Safonova L.P., Gupta R., Toronov V., Michalos A., Paunescu L.A., and Gratton E., "Functional fast neuronal signals in the visual and motor cortex detected by frequency-domain near-infrared spectroscopy"

2001: SPIE international symposium on Medical Imaging, San Diego, CA, USA: Toronov, V., A. Webb, J. H. Choi, M. Wolf, E. Gratton and D. Hueber, "Simultaneous Assessment of Human Brain Functional Hemodynamics by Magnetic Resonance and Near-Infrared Imaging - **Invited**"

2001: Photonics West, International Biomedical Symposium BiOS'99, San Jose, CA, USA: Toronov, V., A. Webb, J. H. Choi, M. Wolf, E. Gratton and D. Hueber. "Simultaneous Functional Magnetic Resonance and Near-Infrared Imaging of Adult Human Brain"

2000: Biomedical Optical Spectroscopy and Diagnostics , Spring Topical OSA Meeting, Miami-Beach, USA:

Toronov, V., M. Wolf, A. Michalos, and E. Gratton. Analysis of cerebral hemodynamic fluctuations measured simultaneously by magnetic resonance imaging and near-infrared spectroscopy.

Wolf, M., V. Toronov, U. Wolf, L. A. Paunescu, A. Michalos, and E. Gratton. Maps of cerebral hemoglobin concentration changes obtained by near-infrared spectroscopy, Characterization of phase shifts among locations. (Poster Presentation).

Wolf, U., M. Wolf, V. Toronov, A. Michalos, L. A. Paunescu, and E. Gratton. Detecting cerebral functional slow and fast signals by frequency-domain near-infrared spectroscopy using two different sensors. (Poster Presentation).

Michalos, A., L. A. Paunescu, M. Wolf, U. Wolf, V. Toronov, M. A. Franceschini, S. Fantini, and E. Gratton. Assessment of cerebral oxygenation and hemodynamics in obstructive sleep apnea syndrome. SuH16. (Poster Presentation).

Franceschini, M. A., S. Fantini, V. Toronov, M. E. Filiaci, M. P. Wolf, A. Michalos, and E. Gratton. Real-time video of brain activation in human subjects using a non-invasive near-infrared technique.

1999: Photonics West, International Biomedical Symposium BiOS'99, San Jose, CA, USA: Toronov, V., M. Filiaci, M. A. Franceschini, S. Fantini, and E. Gratton, Photon-density-wave fluctuation-correlation-spectroscopy: study of coherence in the brain and muscles.

1998: Biomedical Optical Spectroscopy and Diagnostics , Spring Topical OSA Meeting, Orlando, USA:

Toronov, V., M. Filiaci, S. Fantini, and E. Gratton. Study of Fluctuations in Turbid Media by Intensity-Modulated Correlation Spectroscopy.

Filiaci, M., V. Toronov, S. Fantini, and E. Gratton. Optical Probe and Frequency-Domain Instrumentation to Study Spatial and Temporal Correlations of Fluctuations in Tissues. (Poster Presentation).

- 1996: International Conference on Nonlinear Dynamics, Saratov, Russia: Toronov, V. Yu., V.L. Derbov, A.G. Vladimirov, "Geometric structure of the complex Lorenz model"
- 1995: Nonlinear Dynamics in Optical Systems'95, Rochester, N.Y.
- 1995: Joint International Conferences on Coherent and Nonlinear Optics and Laser Optics, St.-Petersburg, Russia
- 1995: International Conference on Nonlinear Dynamics, Chaotic and Complex Systems, Zakopane, Poland
- 1994: 5th European Quantum Electronics Conference, Amsterdam, The Netherlands
- 1993: Computer Simulations in Nonlinear Optics, Moscow-N. Novgorod, Russia
- 1992: Nonlinear Dynamics in Optical Systems'92, Alpbach, Austria
- 1991: Third all - Union School on Nonlinear Oscillations in Radio Physics and Electronics, Saratov, Russia
- 1990: Nonlinear Dynamics in Optical Systems'90, Afton, Oklahoma, USA
- 1989: Second All - Union School on Nonlinear Oscillations in Radio Physics and Electronics, Saratov, Russia

Publications

A. Research Articles

1. Toronov, V., E. D'Amico, D. Hueber, E. Gratton, B. Barbieri, and A. Webb, "Optimization of the signal-to-noise ratio of frequency-domain instrumentation for near-infrared spectro-imaging of the human brain," *Opt. Express* **11**, 2717-2729 (2003), <http://www.opticsexpress.org/abstract.cfm?URI=OPEX-11-21-2717>
2. Toronov, V., Webb, A., Walker, S., Gupta, R., Choi, J. H., Gratton, E., and Hueber, D., The Roles of Changes in Deoxyhemoglobin Concentration and Blood Volume in the fMRI BOLD Signal, *Neuroimage*, *19*, 1521-1531 (2003).
3. Wolf M., Wolf U., Choi J.H., Toronov V., Paunescu L.A, Michalos A., Gratton E. Fast cerebral functional signal in the 100ms range detected in the visual cortex by frequency-domain near-infrared spectroscopy, *Psychophysiology*, *40*, 521-528 (2003).
4. Wolf, M., Wolf, U., Toronov, V., Michalos, A., Paunescu, L.A., Choi, J.H., and Gratton E., Different Time Evolution of Oxyhemoglobin and Deoxyhemoglobin Concentration Changes in the Visual and Motor Cortex during Functional Stimulation: A near Infrared Spectroscopy Study, *Neuroimage*, *16*, 704-712 (2002).
5. Wolf, M., M. A. Franceschini, L. A. Paunescu, V. Toronov, A. Michalos, U. Wolf, E. Gratton, and S. Fantini. Absolute frequency-domain pulse oximetry of the brain: Methodology and measurements. *Proc. 27th Ann. Mtg. ISOTT*, Eds., J. F. Dunn and H. M. Swartz, Pabst Sci. Pub. (2002), in press.
6. Toronov, V., A. Webb, J. H. Choi, M. Wolf, L. Safonova, U. Wolf, and E. Gratton. "Study of Local Cerebral Hemodynamic Fluctuations by Simultaneous Frequency-Domain near-infrared spectroscopy and fMRI", *Optics Express* *9*(8), 417-427 (2001).

7. Toronov, V., A. Webb, J. H. Choi, M. Wolf, A. Michalos, E. Gratton and D. Hueber, "Investigation of human brain hemodynamics by simultaneous near-infrared spectroscopy and functional magnetic resonance imaging" *Medical Physics* 28(4), 521-527 (2001).
8. Toronov, V., M. A. Franceschini, M. Filiaci, S. Fantini, M. Wolf, A. Michalos, and E. Gratton. Near-infrared study of fluctuations in cerebral hemodynamics during rest and motor stimulation: Temporal analysis and spatial mapping, *Med. Phys.* 27(4), 801-815 (2000).
9. Franceschini, M. A., V. Toronov, M. Filiaci, E. Gratton, and S. Fantini, On-line optical imaging of the human brain with 160-ms temporal resolution, *Optics Express* 6(3), 49-57 (2000).
10. A.G. Vladimirov, V.Yu. Toronov and V.L. Derbov, "Properties of the phase space and bifurcations in the complex Lorenz model", *Technical Physics*, 43, 877-884 (1998)
11. V.Yu. Toronov, M. Filiaci, S. Fantini, and E. Gratton, "Photon-density wave correlation spectroscopy detects large-scale fluctuations in turbid media", *Phys. Rev. E*, 58, 2288-2297 (1998)
12. A.G. Vladimirov, V.Yu. Toronov and V.L. Derbov, "The complex Lorenz model: geometric structure, homoclinic bifurcation and one-dimensional map", *Int. J. of Bifurcations and Chaos*, 8, 723-729 (1998)
13. V.Yu. Toronov, V.L. Derbov, "Topological properties of laser phase", *J. Opt. Soc. Am.* 15, 1282-1290 (1998).
14. V.Yu. Toronov, V.L. Derbov, "Geometric phases in a ring laser", *Quantum Electronics*, v. 27 No.7, p. 644-648 (1997)
15. V.Yu. Toronov, V.L. Derbov, "Boundedness of attractors in the complex Lorenz model", *Phys. Rev. E*, 55, 3689-3692 (1997)
16. V.Yu. Toronov, V.L. Derbov, A.G. Vladimirov "On the complex Lorenz model", *Prikl. Nelin. Dinamika*, 3, No 6, 65 (1995)
17. V.Yu. Toronov, V.L. Derbov, "Geometric - phase effects in laser dynamics", *Phys. Rev. A*, 50, 878 (1994)
18. V.Yu. Toronov, V.L. Derbov, "Geometric phases in lasers and liquid flows", *Phys. Rev. A*, 49, 1392 (1994)
19. A.N. Oraevsky, V.Yu. Toronov, "Influence of fluctuations on the attractor in a single-mode laser model", *Soviet J. of Quant. Electron.*, 16, 2063-2069 (1989)
20. A.N. Oraevsky, I.E. Protsenko, M.A. Safonova, V.Yu. Toronov, "Dynamic operation of a laser with two resonance lines of the active medium", *Radio Phys. and Quant. Electron.*, 31, 219-229 (1988)

B. Review Articles (by request from editorial boards)

1. V.Yu. Toronov, V.L. Derbov, O.M. Priyutova, "Geometric phases in nonlinear dynamics of optical systems", *Prikl. Nelin. Dinamika*, 3, No 6, 1 (1995)
2. V. Toronov, E. Gratton, and A. Webb, Simultaneous Near-Infrared Spectroscopy and Magnetic Resonance Imaging of Functional Activity in the Human Brain, in *Research Advances in Medical Physics* 1, p. 1-15, R.M. Mohan ed., Global Research Network (2003)

C. Educational Works

1. Simonenko G., Toronov V., Tatarkova S., and Tuchin V., "Modeling in Physics and Biomedical Optics" (Textbook), Publisher: Saratov State University, 1996, ISBN 5- 292-01416-8, in Russian

2. Toronov V., Photon Density Wave Imaging, Article for Encyclopedia of Modern Optics, Academic Press (UK, B.D. Guenther, A. Meller, L. Bayvel, and J.E. Midwinter, eds), 2002, in press

D. Proceedings

1. V. Toronov, A. Webb, J. H. Choi, M. Wolf, E. Gratton and D. Hueber, "Simultaneous functional magnetic resonance and near-infrared imaging of adult human brain", In *Proc. SPIE Vol.4250*, 380-382 (2001)
2. V. Toronov, S. Fantini, M. Franceschini, M. Filiaci, M. Wolf, and E. Gratton. "Temporal analysis of fluctuations in cerebral hemodynamics revealed by near-infrared spectroscopy", *Proc. SPIE Vol.4001*, 224-227 (2000)
3. Franceschini, M.A., V. Toronov, M. E. Filiaci, M. Wolf, A. Michalos, E. Gratton, and S. Fantini. Real-time video of cerebral hemodynamics in the human brain using non-invasive optical imaging. *Neuroimage 11(5)* S454 (2000).
4. Wolf, M., U. Wolf, V. Toronov, L. A. Paunescu , A. Michalos, M. A.Franceschini , S. Fantini, and E. Gratton. Fast cerebral functional signals in the 100 ms range detected by frequency-domain near-infrared spectroscopy. *Neuroimage 11(5)* S515 (2000).
5. M.A. Franceschini, S. Fantini, V. Toronov, M. E. Filiaci, and E. Gratton, "Cerebral hemodynamics measured by near-infrared spectroscopy at rest and during motor activation", In *Proc. Inter-Institute Workshop on In Vivo Optical Imaging at the NIH*, A. Ganjbakhche ed.,(Optical society of America, Washington DC) pp. 73-80 (1999).
6. M. Filiaci, V. Toronov, S. Fantini, and E. Gratton, "Optical probe and frequency-domain Instrumentation to study spatial and temporal correlations of fluctuations in tissues", in *Biomedical Optical Spectroscopy and Diagnostics/ Therapeutic Laser Applications*, TOPS Volume 22, E. M. Sevic-Muraca, J. A. Izatt, and M. N. Ediger (Eds.), (Opticals Society of America, 1998) pp.183-187
7. V. Toronov, M. Filiaci, M. Franceschini, S. Fantini, and E. Gratton. "Exploring tissue dynamics by photon-density-wave fluctuation correlation spectroscopy", *Proc. SPIE Vol.3726, Light Scattering Technologies for Mechanics, Biomedicine, and Material Science*, V.V. Tuchin, V. P. Ryabukho, and D.A. Zimnyakov Eds (SPIE, 1999) pp. 555-559
8. V. Toronov, M. Filiaci, S. Fantini, and E. Gratton, "Study of large scale fluctuations in turbid media by photon-density-wave fluctuation correlation spectroscopy", in *Advances in Optical Imaging and Photon Migration*, TOPS Volume 21, James G. Fujimoto and Michael S. Patterson, Eds., (Optical Society of America, 1998) pp. 60-62
9. V.Yu. Toronov, V.L. Derbov, O.M. Priyutova, "Geometric phases in the dynamics of nonlinear optical systems", *Proc. SPIE Vol. 3177, Current Russian Research in Optics and Photonics on Nonlinear Dynamics of Laser and Optical Systems*, Valery V. Tuchin; Ed. (SPIE 1997), p. 26-48
10. A.G.Vladimirov, V.Yu.Toronov and V.L.Derbov, "Complex Lorenz Equations", *Proc. SPIE Vol. 3177, Current Russian Research in Optics and Photonics on Nonlinear Dynamics of Laser and Optical Systems*, Valery V. Tuchin; Ed. (SPIE 1997) , pp. 97-106
11. V.Yu. Toronov, V.L. Derbov, "Geometric phase in multimode lasers", *Proc. SPIE Vol. 2792, Laser Optics '95: Nonlinear Dynamics in Lasers*, Neal B. Abraham; Yakov Khanin; Eds. (SPIE, 1996), p.p. 112-115
12. V.Yu.Toronov, "Simulation of the self - pulsing instability in an inhomogeneously broadened single - mode laser by the finite - dimensional model", in *OSA Proceedings on Nonlinear Dynamics in optical Systems*, N.B.Abraham, E.M.Garmire, P.Mandel Eds. (Optical Society of America, Washington, D.C., 1991), vol.7, pp.353-363

E. Accepted

1. Jee Hyun Choi, Martin Wolf, Vlad Toronov, Ursula Wolf, Chiara Polzonetti, Dennis Hueber, Larisa P. Safonova, Rajarsi Gupta, Antonios Michalos, William Mantulin, and Enrico Gratton, "Noninvasive determination of the optical properties of adult brain: Near infrared spectroscopy approach", submitted to *J. Biomed. Optics* (2003)