BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
David D. Nolte	Edward M. Purcell Distinguished Professor of Physics and Astronomy

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Cornell University	B. A.	05/81	Physics
University of California at Berkeley	Ph. D.	05/88	Physics
AT&T Bell Labs	PostDoc	08/89	Photonics

A. Personal Statement: My research activities are focused on biomedical light scattering physics and applications and the development of numerical and statistical computational models. Topics of expertise are optical biosensors for biomarker detection, and coherent spectroscopy of living tissue to investigate intracellular dynamics and microrheology. I have been working in laser interferometry and dynamic holography for over 25 years, developing dynamic holographic semiconductor devices at AT&T Bell Labs, and becoming one of the originators of holographic optical coherence imaging, upon which biodynamic imaging is based. Our research team acquired the first holographic volumetric images of living tissue in 2002, and developed the BioCD, a high-speed highly-multiplexed immunoassay platform based on spinning-disk interferometry. More than 180 papers in these areas have been cited nearly 3000 times, and accrue almost 200 new citations per year. In 2005, I was awarded the Herbert Newby McCoy Award, the top scientific award at Purdue University, in recognition of my work in interferometry and holography. I am a Fellow of the American Physics Society (APS), a Fellow of the Optical Society of America (OSA) and a Fellow of the American Association for the Advancement of Science (AAAS). In 2015 I became the Edward M. Purcell Distinguished Professor of Physics and Astronomy. My most recent book is Introduction to Modern Dynamics: Chaos, Networks, Space and Time (Oxford, 2015) that introduces modern concepts of networks and nonlinear dynamics to undergraduates including neural network simulations.

Relevant Publications:

1) Ran An, Dan Merrill, Larisa Avramova, Jennifer Sturgis, Maria Tsiper, J. Paul Robinson, John Turek and David D. Nolte, Phenotypic Profiling of Raf Inhibitors and Mitochondrial Toxicity in 3D Tissue using Biodynamic Imaging, J. Biomolec. Screening, 19, 526-537 (2014)
2) D. Merrill, R. An, J. J. Turek, D. D. Nolte, Digital Holography of Intracellular Dynamics to Probe Tissue Physiology, Appl. Opt. **54**, A89-A97 (2015)
3) Ran An,Chunmin Wang, John Turek, Zoltan Machaty, and David D. Nolte, Biodynamic imaging of live porcine oocytes, zygotes and blastocysts for viability assessment in assisted reproductive technologies, Biomed. Opt. Exp. vol. 6, no. 3, 963-976 (2015)
4) M. R. Custead, J. J. Turek, R. An, D. D. Nolte, and M. O. Childress, Use of biodynamic imaging to predict treatment outcome in a spontaneous canine model of non-Hodgkin's lymphoma, Convergent Science of Physical Oncology, vol. 1, p. 015003 (2015).

B. Positions and Honors:

Positions and Employment

1988 - 1989	Postdoctoral Member of Technical Staff, AT&T Bell Labs
1989 - 1994	Assistant Professor, Dept. of Physics, Purdue University
1994 - 1999	Associate Professor, Dept. of Physics, Purdue University
1999 - 2015	Full Professor, Dept. of Physics, Purdue University
2015 - present	Edward M. Purcell Distinguished Professor of Physics and Astronomy

Other Experience and Professional Memberships

1986-	Member, American Physical Society
1986-	Member, American Association for the Advancement of Science
1988-	Member, Optical Society of America
2000-2002	Founder, Holocan Ltd.
2000-2002	NATO Science for Peace consultant
2004	PRC National Invited Lecturer, Nankai University
2005-2009	Founder and Consultant, Quadraspec, Inc.
2011 - 2016	Founder and President, Animated Dynamics Inc.
2016 -	Chief Scientific Officer, Animated Dynamics Inc.

Honors

1990	Alfred P. Sloan Research Fellowship
1991	Presidential Young Investigator, NSF
1997	Fellow of Optical Society of America
1997	Spira Award for Best Undergraduate Physics Teacher, Purdue University
2003	University Faculty Scholar, Purdue University
2003	Fellow of the American Physical Society
2005	Herbert Newby McCoy Award of Science, Purdue University, 2005
2006	Techpoint MIRA Award for Business Innovation of the Year, 2006
2012	Fellow of the American Association for the Advancement of Science
2015	Techpoint MIRA Award for Technology Innovation of the Year

C. Contributions to Science

1. Biodynamic Imaging and Tissue Dynamics Spectroscopy. Our Purdue group invented and developed biodynamic imaging (BDI) which is a novel 3D live-tissue imaging technology that uses low-coherence infrared digital holography that performs Doppler spectroscopic imaging inside living 3D tissue culture and biopsies. Biodynamic imaging measures the physiological intracellular motion influenced by drug action in living tissue and identifies biodynamic biomarkers that correlate strongly with clinical patient sensitivity to applied anticancer therapeutics. Biodynamic microscopy is a new form of microscopy that applies to any living tissue, including organoids as well as oocytes and embryos. Our group has published 28 papers in this field of research with applications since 1996, has one issued patent and 8 patents pending.

P. Yu, M. Mustata, J. J. Turek, P. M. W. French, M. R. Melloch, and D. D. Nolte, "Holographic optical coherence imaging of tumor spheroids," *Applied Physics Letters,* vol. 83, pp. 575-577, Jul 21 2003.

K. Jeong, J. J. Turek, and D. D. Nolte, "Volumetric motility-contrast imaging of tissue response to cytoskeletal anti-cancer drugs," *Optics Express,* vol. 15, pp. 14057-14064, Oct 17 2007.

K. Jeong, J. J. Turek, and D. D. Nolte, "Fourier-domain digital holographic optical coherence imaging of living tissue," *Applied Optics,* vol. 46, pp. 4999-5008, Aug 1 2007.

D. D. Nolte, R. An, J. Turek, and K. Jeong, "Holographic tissue dynamics spectroscopy," *Journal of Biomedical Optics,* vol. 16, Aug 2011.

2. The BioCD and Molecular Interferometric Imaging. The BioCD is a spinning-disc detection platform that uses laser interferometry to detect protein bound on the disc surface. The interferometric detection uses common path configurations that are insensitive to surface vibrations. The common path configurations include microdiffraction, adaptive optical, phase contrast and in-line optical configurations. In-line interferometric phase quadrature for sensitive phase-to-intensity transduction is achieved using an eighth-wave thermal oxide on silicon wafers. Direct imaging of protein on the wafers is possible, called molecular interferometric imaging (MI2), that has the advantage of high spatial resolution for the study of protein binding on printed antibody arrays. Our group has published 12 peer-reviewed papers in this field of research with applications since 2004 and has 11 issued patents.

M. M. Varma, H. D. Inerowicz, F. E. Regnier, and D. D. Nolte, "High-speed label-free detection by spinning-disk micro-interferometry," *Biosensors & Bioelectronics,* vol. 19, pp. 1371-1376, Jun 15 2004.

D. D. Nolte, "Invited Review Article: Review of centrifugal microfluidic and bio-optical disks," *Review of*

Scientific Instruments, vol. 80, Oct 2009.
M. Zhao, D. Nolte, W. Cho, F. Regnier, M. Varma, G. Lawrence, and J. Pasqua, "High-speed interferometric detection of label-free immunoassays on the biological compact disc," *Clinical Chemistry,* vol. 52, pp. 2135-2140, Nov 2006.
X. Wang, M. Zhao, D. D. Nolte, and T. L. Ratliff, "Prostate specific antigen detection in patient sera by fluorescence-free BioCD protein array," *Biosensors & Bioelectronics,* vol. 26, pp. 1871-1875, Jan 15 2011.

3. Photorefractive Quantum Wells and Nonlinear Optics Photorefractive quantum wells have the highest-sensitivity nonlinear index of any nonlinear optical material. They were invented at AT&T Bell Labs by Nolte, Knox and Glass in 1989, and were extensively developed by the Nolte group at Purdue, investigating the nonlinear optics and nonlinear transport in these materials and devices. The high sensitivity of these dynamic holographic materials made them attractive for applications in laser-based ultrasound detection, femtosecond optical processing, and imaging through turbid media. Our group has published 40 peer-reviewed papers in this field of research with applications since 1989 and has 2 issued patents.

D. D. Nolte, "Semi-insulating semiconductor heterostructures: Optoelectronic properties and applications," *Journal of Applied Physics,* vol. 85, pp. 6259-6289, May 1 1999.
Q. Wang, R. M. Brubaker, D. D. Nolte, and M. R. Melloch, "Photorefractive Quantum Wells: Transverse Franz-Keldysh Geometry," *Journal of the Optical Society of America B-Optical Physics,* vol. 9, pp. 1626-1641, Sep 1992.
I. Lahiri, L. J. Pyrak-Nolte, D. D. Nolte, M. R. Melloch, R. A. Kruger, G. D. Bacher, and M. B. Klein, "Laser-based ultrasound detection using photorefractive quantum wells," *Applied Physics Letters,* vol. 73, pp. 1041-1043, Aug 24 1998.
Y. Ding, R. M. Brubaker, D. D. Nolte, M. R. Melloch, and A. M. Weiner, "Femtosecond pulse shaping by dynamic holograms in photorefractive multiple quantum wells," *Optics Letters,* vol. 22, pp. 718-720, May 15 1997.

4. Deep Level Spectroscopy of Semiconductors Deep-level defects in semiconductors control the electrical conductivity and optical absorption of these technologically important materials. Nolte made important original contributions to deep-level spectroscopy, with emphasis on universal properties of transition-metal impurities that enabled the first measurement of fundamental physical properties of semiconductors related to their ultimate limits of electronic transport. Our group has published 20 peer-reviewed papers in this field of research with applications since 1986.

D. D. Nolte, W. Walukiewicz, and E. E. Haller, "Band-edge hydrostatic deformation potentials in III-V semiconduc tors," *Physical Review Letters,* vol. 59, pp. 501-504, Jul 27 1987.
D. D. Nolte, D. H. Olson, and A. M. Glass, "Nonequilibrium screening of the phorotrefractive effect," *Physical Review Letters,* vol. 63, pp. 891-894, Aug 21 1989.
E. S. Harmon, M. R. Melloch, J. M. Woodall, D. D. Nolte, N. Otsuka, and C. L. Chang, "Carrier lifetime versus anneal in low-temperature growth GaAs," *Applied Physics Letters,* vol. 63, pp. 2248-2250, Oct 18 1993.
M. R. Melloch, J. M. Woodall, E. S. Harmon, N. Otsuka, F. H. Pollak, D. D. Nolte, R. M. Feenstra, and M. A. Lutz, "Low-temperature-grown III-V materials," *Annual Review of Materials Science,* vol. 25, pp. 547-600, 1995 1995.

5. Percolation Theory and Fractals Nolte has made important contributions to the application of fractals and percolation theory to geophysics, specifically to fluid flow through natural fractures in rock. Percolation theory studies the network connectivity of transport paths through random media. Applications relate to the protection of ground water and the recovery of oil and gas for energy production. Recent contributions have revolved around the role of capillarity in the distribution of multiple phases within random pore geometries. Our group has published 10 peer-reviewed papers in this field of research with applications since 1986.

L. J. Pyrak-Nolte, N. G. W. Cook, and D. D. Nolte, "Fluid percolation through single fractures," *Geophysical Research Letters,* vol. 15, pp. 1247-1250, Oct 1988.
J. T. Cheng, L. J. Pyrak-Nolte, D. D. Nolte, and N. J. Giordano, "Linking pressure and saturation through interfacial areas in porous media," *Geophysical Research Letters,* vol. 31, Apr 22 2004.

D. D. Nolte, L. J. Pyrak-Nolte, and N. G. W. Cook, "The fractal geometry of flow paths in natural fractures in rock and the approach to percolation," *Pure and Applied Geophysics,* vol. 131, pp. 111-138, 1989 1989.

D. D. Nolte and L. J. Pyrak-Nolte, "Stratified continuum percolation: Scaling geometry of hierarchical cascades," *Physical Review A,* vol. 44, pp. 6320-6333, Nov 15 1991.