

# Donald Barnhart, PhD

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## Director/Senior-Level Manager of Engineering Research

- Collaborative leader thriving in innovative environments.
- Proven history of developing innovative, award-winning software and instrumentation.
- Extensive experience in designing, implementing, and successfully executing cutting-edge instruments to satisfy the customer.

### OBJECTIVE

Responding to requirements with visionary solutions and directing their implementation by supporting an interdisciplinary team of scientists and engineers. Creating an environment encouraging team cooperation, mentoring, feedback, and deliverable performance.

### SELECTED ACCOMPLISHMENTS

- **Creator of Optica modeling and analysis software;** used by >2000 scientists world-wide for over 25 years.
- **Principal Optical Architect of Sony's flow cytometer systems;** total sales now exceeding **\$100 million.**
- **Founder of the holographic velocimetry discipline;** awarded key patent that generated income through its license. (*University of Illinois*)
- **Pioneer of HPC (High Performance Computing);** primarily applied to optical engineering to obtain solution in 3 weeks that would have required 3 years to calculate on a normal computer. (*Sony*)
- **Honored by the Queen of England at Buckingham Palace;** "Queens Anniversary Prize" in optical innovation. (*Loughborough University*)
- **Solved key problem in Augmented Reality (AR);** cornerstone patent. (*Trex Enterprises*)
- **Reduced speckle in semiconductor fabrication by 50%;** reducing production time by 5-7% and saving industry **hundreds of millions of dollars;** key solution patented. (*ASML*)
- **Enhanced Digital Holographic Microscopy with bacteriorhodopsin;** >9 orders of magnitude gain. (*UM*)
- **6 Patents in 5 diverse subject areas; 24 publications; 350 citations.**

### PROFESSIONAL EXPERIENCE

#### Optica Software, San Diego, CA

1994—Present

##### Creator/Founder

- Developed Optica, an optical design, modeling, and analysis software package extending Mathematica.
- As a graduate student at the University of Illinois in 1991, I started developing Optica to enable the creation of the first successful holographic camera to capture a million points simultaneously in a three-dimensional fluid flow. These ground-breaking results appeared on the front cover of Applied Optics in 1994. Optica Software was founded with the first commercial release of the optical package for Mathematica. Since then, the 'Optica' package has acquired a loyal following of users in the optical sciences community.
- Support Optica software with research, development of upgrades, testing, and technical support, linked to customer feedback.
  - Advise scientists world-wide on many different optical applications including solar energy, extreme ultraviolet lithography, holographic optical elements, solar concentrator design, laser systems, x-ray diffraction gratings, optical coherence tomography (OCT), ophthalmology, and remote sensing.
  - Supervise and manage 1-3 employees in sales, technical support, and financial management.
  - Regularly present optical solutions at various venues, enhancing capability to address new challenges.
  - Clients include NASA, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Harvard University, University of Oxford, Microsoft Corporation, Canon USA, Intel Corporation, Sony Corporation, and Zebra Imaging.

**Cymer/ASML, San Diego, CA****Feb 2016 - Feb 2019: Full-time Employee**Staff Optical Engineer

- Developed 193 nm deep ultraviolet (DUV) laser systems for ASML's photolithography scanners.
- Updated and maintained DUV performance, working with manufacturers, engineers, and users.
- Specified and engineered modular instruments involving electro-optics, electrical and electronic engineering, mechanical engineering, and software specification, creation and testing.
- Guided development teams and design reviews to assure compliance with all requirements.
- Planned and managed complex development projects involving EO, EE, ME, and SW elements and including key deliverables, timeline, and budget.
- Led integration and test of laser systems from early concepts through field deployment.
- Solved key optical problem for speckle reduction with industry-wide impact in semiconductor manufacture.
- Architect for more than 10 invention disclosures in 3 years, resulting in 3 patent filings, two of which created a new patent category for a company already awarded thousands of patents.

**Trex Enterprises Incorporated, San Diego, CA****Oct 2015 - Jan 2016: Consultant****Sept 2014-Sept 2015: Employee**Senior Optical Scientist

- Created the architectural concept and details of computer-generated diffractive optics implementing head-worn displays for virtual reality (VR) and augmented reality (AR) applications.
- Filed patent on holographic head-worn displays for both VR and AR.

**Sony Biotechnology Corporation (formerly i-Cyt), Champaign, IL****2004—2012**Principal Optical Scientist

- Designed and oversaw the manufacture of Sony Biotechnology's flow cytometer optical systems incorporating the most advanced optical, electronic, and signal processing hardware and software algorithms.
- Provided full lifecycle management of development for all optical hardware in biotech medical instruments.
- Streamlined production processes and ensured that production adhered to regulatory standards.
- Trained and supervised engineers, production line operators, and field technicians.

**Physical Chemistry, University of Marburg (UM), Marburg, Germany****2003—2004**Visiting Scholar

- Enhanced Holographic Microscope based on bacteriorhodopsin with a billion-fold performance improvement.

**University of Illinois at Urbana-Champaign, Urbana, IL****2002—2003**Post Doctoral Research Associate

- Post doctorate research in the measurement of supersonic micro-detonations.

**Loughborough University Mechanical Engineering Department, England****2001—2002**Post Doctoral Research Associate

- Received funding to continue doctoral research in advanced development of holographic metrology.
- Designed a holographic camera system capable of measuring both fluid and surface movement.

**Holoflex Start-up, Urbana, IL****1988—1990**President/Founder

- Holoflex was founded to produce holographic portraits of people with a new technology that I invented.

**EDUCATION****PhD, Mechanical Engineering, Loughborough University, England (2001)**

Dissertation: "Whole-field Holographic Measurements of Three Dimensional Displacement in Solid and Fluid Mechanics."

- Won the Rank Prize Funds Award for the best electro-optics PhD Dissertation in the United Kingdom.
- Member of the Optical Engineering Group, awarded the Queen's Anniversary Prize for Higher and Further Education.
- Developed optical hardware systems for holographic measurement with an academic research budget approaching \$1M.

## MS, Electrical Engineering, University of Illinois, Urbana-Champaign, IL (1994)

Dissertation: "Phase Conjugate Holographic System for High Resolution Particle Image Velocimetry"

- Demonstrated the world's first successful holographic instrument \*to measure 3D velocity fields in fluids. This resulted in a patent (#US 5,548,419, Aug 20, 1996) (licensed to an independent non-affiliated company) and a featured article in *Applied Optics* journal (Oct 20, 1994).

## BS, Electrical Engineering, University of Illinois, Urbana-Champaign, IL (1987)

### AREAS OF EXPERTISE

- **Innovation:** >25 years experience in optical modeling, simulation, and systems design and fabrication including flow cytometry, colorimetry, spectroscopy, holographic microscopy, lasers, x-ray sources, and scanning-electron microscopy. Deep understanding of particle/biological cell scattering, particle-field measurement, head-worn displays, DUV lasers, ophthalmic systems, velocity field mapping, and shape measurement.
- **Software & Hardware:** Expert in developing optical and mechanical software and hardware systems including concept, drawings, optimizing design, prototype testing, manufacturing, and validation.
- **Data Analysis:** Expert in data handling and analysis in scientific and high-performance computing.
- **Project Management:** Technical project manager with wide experience leading development and implementation teams from concept through the launch of new products. Management of multi-disciplinary teams comprising engineers, technicians, manufacturing, and sales personnel.
- **Communication:** Track record of forging consensus among diverse multilevel, cross-functional, and multidisciplinary groups. Proficient in communicating technical material, and in building positive relationships with clients and vendors. Conversational proficiency in German.
- **Computer Generated Holograms:** Developed algorithms and produced computer generated holograms and holographic optical elements containing over 100 billion pixels.
- **Head-Worn Displays:** 3 years of experience developing head-worn displays.
- **Lasers:** 3 years experience developing 193/248 nm lasers, and pioneering early extreme (EUV) lasers.
- **Optical Design:** Gaussian beam optics, imaging and non-imaging systems, laser modeling, laser coupling, free-form optics, x-ray optics, solar concentrators, ultra-fast lasers, and laser pump design.
- **Optical & Mechanical Software:** Optica, SolidWorks, Zemax, and CodeV.
- **Languages:** Mathematica, Wolfram language, C, Pascal, iOS programming, Python, and MatLab, to include a few.

### PATENTS

<https://www.opticasoft.com/donaldspatents>

- Methods and Apparatuses for Aligning and Diagnosing a Laser Beam. #0025536A1, Published on Jan 24, 2019.
- Reducing Optical Damage on an Optical Element. #0004218A1, Published on Jan 3, 2019.
- Reducing Speckle in a Pulsed Light Beam. #002-169P02, Filed on August 21, 2018.
- Optical See-Through Head Worn Display. #0084232A1, Published on March 22, 2018
- Optical Device. (SlideOScope Invention) #US 9,594,251 Issued on March 14, 2017
- Stereo Multiplexed Holographic Particle Image Velocimeter. #US 5,548,419 Issued on Aug 20, 1996.

### SELECTED PUBLICATIONS

[https://www.researchgate.net/profile/Donald\\_Barnhart/publications](https://www.researchgate.net/profile/Donald_Barnhart/publications)

1. Bit-mapped holograms using Phase Transition Mastering (PTM) and Blu-ray disks. (2013) *Journal of Physics*.
2. Partially coherent extreme ultraviolet interference lithography for 16 nm patterning research. (2008) *Applied Physics Letters*.
3. Optical Mounts: Stress-free mounting enables diffraction-limited performance. (April 2007) *Laser Focus World*.
4. Holographic velocimetry with Object Conjugate Reconstruction (OCR): Simultaneous velocity mapping in fluid and solid mechanics. (May 6, 2004) *Proceedings of the Royal Society of London*.
5. Bacteriorhodopsin (BR) as a high-resolution, high-capacity buffer for digital holographic measurements. (March 19, 2004) *Measurement, Science, and Technology*.
6. Object Conjugate Reconstruction (OCR): A step forward in holographic metrology. (June 17, 2002) *Proceedings of the Royal Society of London*.
7. Phase-conjugate holographic system for high-resolution particle-image velocimetry. (Oct 20, 1994) *Applied Optics*.