

KURTIS KELLER

3421 Carriage Tr.
Hillsborough, NC 27278

Research Engineer Designer Optical-Mechanical

Education:

1994 M.S. North Carolina State University, Integrated Manufacturing Systems Engineering,

1988 B.S. North Carolina State University, Mechanical Engineering.

Post grad & Business MBA

Launching the Company Series, UNC's Kenan Flagler Business School

Optical Perception, UNC

Patent Law (2 classes), NCSU, UNC

Optical Mounting, U Arizona.

Business Law, NCSU

Professional:

2003 - President to Engineering Director & COO, InnerOptic Technology Inc. Chapel Hill, NC (split time with UNC).

1993 - Research Engineer, Microelectronic Systems Laboratory, Department of Computer Science, University of North Carolina Chapel Hill. (split time with InnerOptic).

2000 – 2001 3rdTech, Senior Mechanical Engineer, Chapel Hill, NC (part time).

1988 – 1993 Mechanical Engineer, Matrix Corporation, Raleigh North Carolina.

1984 – 1987 Machining, CNC programming, Kamtec Incorporated, Mebane, NC

1983 - 1984 President, Kwest Robotics Incorporated, Mebane, NC.

Expert witness:

Provided expert witness testimony, declarations and depositions for multiple patents for both prosecution and defense. Depositions were on location or video-taped with court recorder and attorneys on both sides; items included invalidity, infringement, claim construction, etc..

Expert witness for the following categories: Optical packaging and mounting (cameras, projectors, etc.), Electronic packaging and Electronic thermal related patents: 6,203,158; 5,297,005; 6,402,324; 6,527,392; 6,558,004; 6,644,817; 6,739,831; and 6,742,899. Seiko Epson Corporation, vs. Coretronic Corporation; Civil Action No. 3:06-cv-06946-MHP, Northern District of California, San Francisco Division; Jury.

Real3D Corp, stereo projectors US patents #8,220,934; 7,857,455; 7,959,296; and 7,905,602, opinions only, no court.

Expert witness for medical, surgical computer interface / display for Karl Storz. Includes depositions and scheduled in-court appearance, US patent numbers 8,069,420 and 7,844,657. Northern District of California, San Francisco Division; Jury. Currently ongoing, 2017.

Axon 1028

Axon v. Digital Ally

U.S. Pat. No. 9,712,730

Major Projects: Opto-Mechanical

Video See-through camera mounts and displays. System with dual streaming video cameras mounted into individual pods integrated to Head Mounted Display. Used for first published virtual/ augmented reality surgery on human patients.

6 shared nodal point camera system. System utilizing six cameras with lenses utilizing a technique of shared apertures with mirrors to create very high resolution 180 degree FOV display.

Custom camera mounting for personnel mounted, individual monitoring system. Two camera systems of various geometry of cameras mounted to real-time monitor person who is wearing and being observed. Includes audio monitoring. One system known as the Narwhale system.

FEA meshing of 3D depth data Create 3D skin textures from anatomical features in real time from feature scanning. Tested on porcine donors.

3D depth extraction of hard and soft anatomical features. Real-time structured light depth extraction on hard and soft anatomical features. 3D data extracted through multiple software algorithms and user allowed to manipulate 3D data; combines custom mounted tracked cameras and depth extraction.

Integrated Camera mounting, military weapons. Design and build system to combine both tracker system and cameras onto military weapons, trainer systems.

3D guidance of tools and shifting of anatomical structures. Integrating in real-time 3D scans of anatomical items, hard and soft, with rigid and articulating surgical tools.

Head Mounted Displays. Designer and co-designer of ~12 HMDs including optical and video see-through and 12 display Very WFOV Kaiser HMD. Some were helmet, flight-style, others visor-style and some individual pods. Also designed packaging for associated electronics. UNC

Endoscopic Stereo Camera optical and mechanical design and build for custom stereo endoscope.

Single Imager stereo endoscope system design; Camera, scopes and camera interface design for a single imager stereo endoscopic system. Stereo video display

3D endoscope and camera system design and build; 3D depth extraction system through a dual tube endoscope. Includes custom designed camera and central processing unit; stereo video display.

3D projection nursing simulator; rear projection hospital bed with replaceable rear projection mannequins on bed for projective surfaces. 7 projectors, 14 cameras (7 infrared and 7 color), all with custom optical mounts.

AIM Computer assisted surgical system. Lead Engineer for commercial system that combined tracked ablation needles and ultrasound in a full 3D stereo, real-time display to assist surgeons. From conception to fully FDA approved computer system. InnerOptic Technology Inc.

Miniature video see-through HMD. Co-designed, built, patented and sold miniature video see-through HMD. Dual integrated stereo cameras for forward viewing. Used from medical procedures, especially surgery. UNC and licensed to InnerOptic Technology, Inc.

Custom Endoscope design; designed and built multiple custom endoscopes along with co-designed endoscopes put into production, includes multiple stereo scopes including 12, 10 and 5mm diameter versions.

Full FDA 510K approval of video system Medical device; combined tracker, video and ultrasound system. Led project through full FDA (60601-1, -2, UL, and FCC testing). 2 systems approved over 3 years.

Infrared Projectors. Designed and build multiple wideband infrared and laser-based narrowband projectors for imperceptible depth extraction for teleconference and medical use. Includes design of optics, mounts and thermal designs. UNC

Stereo Projectors. Built and modified projectors with new optics for both passive polarization stereo (Sharp) or active stereo (TI micromirrors). Includes design of custom light wheels, collimators, exit optics, cooling and illuminators. UNC

Medical Device FDA and FCC approval process. Worked with team for preparing and submitting 510K of surgical, electronic medical device. Received clearance Fall 2009. Also included detailed UL 60601-1 and 60601-2 electromagnetic design, test and safety approvals. InnerOptic Technology, Inc.

Projector and 3D display detailed evaluation and analysis. Performed studies on both commercial and UNC's own custom-designed DLP and LCD projectors along with 3D display empirical and user study evaluations. UNC. Also, expert witness for several projector patent cases.

High-speed optical cancer detection device. Design for a high-speed optical cancer detection apparatus for cancers. Optical design in the visible and IR with multiple, parallel digital cameras and computer. For cervical, prostate and throat cancers. InnerOptic Technology, Inc.

Major Projects: *Electro- mechanical:*

Custom Industrial robot. Lead mechanical engineer for custom hydraulic robot installed into automotive assembly line. 3 axis plus end-effector. 100% custom design. Rugged, industrial design with 24 hour round the clock operation. Hydraulic with electronic positioning feedback. GKN.

Detailed thermal and vibration design airflow and FEA cooling analysis, for trunkline real-time encryption computers. Detailed MTBF and FITs calculations, design and parts optimization for improving reliability. Cooling design of system for unattended, very high security and reliability encryption computers. For Telcom industry - required *system* MTBF of over 3 years. Much thermal/FEA simulations and re-laying out of enclosures to meet MTBF requirements. Performed tests at testing labs. Cipher Optics and Secant Corp.

Robot collision detection – Designed collision detection hardware and software for tow industrial robots operating in same work environment.

Rugged & Military Computer Series. Designed VME PC board mechanical designs for ultra high vibration, shock and temperature (-40 - +85C) environments. Designed enclosures and systems for MIL, UL & FCC. One series designed to survive & function through depth charge blasts. Matrix Corp.

Custom Surgical Trackers: Designed, simulated (FEA) eight different medical grade plastic injection molded parts and clamps produced in quantity for various tracked surgical tool systems. Full FDA approved sterilization, packaging, labeling along with obtaining FDA approvals. InnerOptic technology, Inc.

Patents: (12 issued, ~6 others pending)

9,792,715, "Methods, systems, and computer readable media for utilizing synthetic animatronics"

9,675,319, "Loupe Display"

9,659,345, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"

9,282,947, "Imager focusing based on intraoperative data"

8,690,776, "Systems, methods, apparatuses, and computer-readable media for image guided surgery"

8,585,598, "Systems, methods, apparatuses, and computer-readable media for image guided surgery"

8,482,606, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"

8,350,902, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"
 8,152,305, "Methods, systems, and computer program products for full spectrum projection"
 7,728,868, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"
 7,385,708, "Methods and systems for laser based real-time structured light depth extraction"
 6,503,195, "Methods and systems for real-time structured light depth extraction and endoscope using real-time structured light depth extraction"

Principal Investigator Activities:

P.I. on NSF 2005 grant 0422102. "Phase II & Phase IIB, Three-Dimensional (3D) Laparoscope";
 P.I. on NSF 2003 grant 0319710. "Phase I, Three-Dimensional (3D) Laparoscope";
 P.I. on NSF 2013 grant 1229471. "Development of Pneumatic Water Wave Genesis, a versatile wavemaker for the UNC Joint Fluids Lab"
 P.I. on ONR 2012 grant 1229471. "Desalinization Facility for Stratifiedfluid Dynamics Research"

Publications:

"Single-imager, Stereo Endoscope"; Kurtis Keller & Andrei State. SPIE Medical Imaging 2011, 2011.
 "Deployable Integral Field Units, Multislits, and Image Slicer for the Goodman Imaging Spectrograph on the SOAR Telescope"; Cecil, Gerald N.; Moffett, A. J.; Cui, Y.; Eckert, K. D.; McBride, J.; Kannappan, S.; Keller, K.; Barlow, B. N.; Dunlap, B.; Bland-Hawthorn, J.. American Astronomical Society; Bulletin of the American Astronomical Society, Vol. 42, p.403, 2010.
 "Head Mounted Displays for Medical Use"; Kurtis Keller, Andrei State, and Henry Fuchs; Invited Paper; Journal of Display Technology, IEEE and OSA, Vol. 4 Number 4, 2008
 "Thin-foil magnetic force system for high-numerical-aperture microscopy "; Fisher, J. K., L. Vicci, J. Cribb, K. Keller, B. G. Wilde, T. O'Brien, K. Desai, , R. M. Taylor II, R. Superfine; Review of Scientific Instruments; 2006.
 "Simulation-Based Design and Rapid Prototyping of a Parallax-Free, Orthoscopic Video See-Through Head-Mounted Display"; Andrei State, Kurtis P. Keller and Henry Fuchs; *Proc. International Symposium on Mixed and Augmented Reality (ISMAR)* 2005 (Vienna, Austria, Oct 5-8), 2005
 "Towards Tumor Detection through Optical Tomography in a 3D Depth Extraction Endoscope"; Kurtis Keller, Adam Wax, Caroline Green, Andrei State, and Henry Fuchs; MMVR, January, 2005.
 "3D Force Microscope: a nanometric optical tracking and magnetic manipulation system for the biomedical sciences"; Fisher, J. K., L. Vicci, J. R. Cummings, K. Keller, B. G. Wilde, T. O'Brien, K. Desai, C. Weigle, G. Bishop, R. M. Taylor II, R. Superfine; Review of Scientific Instruments; October 2004.
 "Severe Environment Conduction-cooled Boards with Daughter Cards - Design Methods and Analysis"; ASME InterPack 2003, Kurtis Keller.
 "Monticello Through the Window"; 4th Symposium on Virtual Reality, Archaeology and Cultural Heritage 2003, Nathaniel Williams, Chad Hantak, Kom-Lim Low, John Thomas, Kurtis Keller, Lars Nyland, David Luebke and Anselmo Lastra.
 "Mixed Reality HMD Design"; VR2002, Andrei State & Kurtis Keller.
 "Surface Reconstruction of Abdominal organs using Laparoscopic Structured Light for Augmented Reality Applications"; Jeremy Ackerman, Kurtis Keller, Henry Fuchs; Electronic Imaging 2002 – Photonics West.

- “Switched Pattern Laser Projection for Real-time Depth Extraction and Visualization through Endoscopes”; Kurtis Keller, Jeremy Ackerman, and Henry Fuchs; 2002, International Symposium on Optical Science and Technology SPIE's 47th annual meeting.
- “Augmented Reality Guidance for Needle Biopsies: A Randomized, Controlled Trial in Phantoms”; MICCAI 2001”; Rosenthal, M. R., State, A., Lee, J., Hirota, G., Ackerman, J., Keller, K., Pisano, E., Jiroutek, M., Muller, K., & Fuchs, H.
- “High-Performance Wide-Area Optical Tracking: The HiBall Tracking System”; Welch, Greg, Gary Bishop, Leandra Vicci, Stephen Brumback, Kurtis Keller, and D'nardo Colucci; 2001 Presence: Teleoperators and Virtual Environments 10(1): 1-21.
- “Real-time Structured Light Depth Extraction”; Kurtis Keller and Jeremy Ackerman; Photonics West – Electronic Imaging, 2000.
- “The HiBall Tracker: High-Performance Wide-Area Tracking for Virtual and Augmented Environments”; Greg Welch, Leandra Vicci, Stephen Brumback, Kurtis Keller, and D'nardo Colucci; VRST99, 1999.
- “Real-time Anatomical 3D depth Extraction”; Jeremy Ackerman and Kurtis Keller, MMVR, 2001.
- “Augmented Reality Visualization for Laparoscopic Surgery”; Fuchs, Henry, Mark A. Livingston, Ramesh Raskar, D'nardo Colucci, Kurtis Keller, Andrei State, Jessica R. Crawford, Paul Rademacher, Samuel H. Drake, and Anthony A. Meyer; MICCAI '98, 1998.
- “Perception in HMDs, what really makes them all so terrible?”; Kurtis Keller and D'nardo Colucci; Lead conference paper; SPIE Aerosense '98, 1998.
- “Cast 3D Heatsink Design Advantages”; Kurtis Keller; IEEE ITherm '98, 1998. Transactions on Components and Packaging Technologies, IEEE press, 2000.
- "Augmented Reality Assistance for Needle Biopsies: From Early Prototypes to a Controlled User Study"; IMPSE, Andrei State, Michael Rosenthal, Joohi Lee, Gentaro Hirota, Jeremy Ackerman, Kurtis Keller, Etta D Pisano and Henry Fuchs.
- “Efficiency and Cost Tradeoffs Between Aluminum and Zinc Die Cast Heatsinks”; Kurtis Keller; InterPack (International Electronic Packaging conf.), Invited talk, 1997.
- “Video See-through HMD for Surgery Assisted by Augmented Reality”; D. Colucci, G. Hirota, K. Keller, A. State, S. Drake, R. Fish; SPIE - EI'97, 1997.
- “Low Cost, High Performance, High Volume Heatsinks”; Kurtis Keller, 1998 IEMT-Europe Symposium, Berlin, 1998.
- “Commercial Packaging Solutions for a Research Oriented Graphics Supercomputer,” Kurtis Keller and John Poulton; InterPack 1995.
- “Video See-through Design for Merging of Real and Virtual Environments”; Emily K. Edwards, Jannick P. Rolland and Kurtis Keller; VRAIS conference, 1993.

Reviewer & Panel Activities:

WSCG 2001, 2002, 2003, 2005, 2007, 2008, 2009 International Conferences on Computer Graphics, Visualization and Computer Vision. 2009 planning and directors committee.

ISMAR 2008, 2009 reviewer, International Symposium on Mixed and Augmented Reality

NIH grant reviewer, 2008 onward

NSF grant reviewer, 2005 onward

Biotech Forum, Expert Panelist Medical Imaging. 2006, Biotech Center RTP.

Maine Business Development 2002