**DAVID KESSLER, Ph.D**

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An accomplished and experienced technical leader, designer and innovator in optical systems, optical engineering, optical sciences and IP. A proven record of conceiving, designing and developing a variety of advanced optical systems. Published 25 papers and 17 presentations in professional conferences, granted 97 U.S. patents.

## Areas of Competence

*Conceiving, designing, and developing products comprised of imaging systems; projection and illumination optics; optical displays and LC display films and backlights; laser flying spot systems; near eye displays; high power laser thermal printers; laser and CCD scanners; microlithographic systems; digital camera optics; auto stereoscopic systems; fluorescent microscopy; laser scanning microscopy; fundus and dental cameras.

* Zemax optical CAD (imaging, illumination and physical propagation modes).

*Aberrations theory; physical optics; laser beam propagation.

* Project and team management.

* IP generation; protection; expert witness.

## Professional Experience

Kessler Optics & Photonics Solutions, Ltd. 2/06-
Consultant
Provide optical designs and optical systems architecture solutions to customers in medical optics, near eye displays, high energy laser systems, imaging optics, microlithographic systems, and laser scanners. Using CodeV, Zemax, Gsolver and custom software. Expert witness experience: preparations, depositions and court testimony.

Light Management Films Program, Display Science and Technology Center, Eastman Kodak Co. 8/04-2/06
Project leader
Displays technology, LCD backlights, OLED light extraction, digital cameras, bio-optics systems, and companywide optical systems consulting.

Engineering Physics Laboratory, Hard Copy and Display Technology Division, Eastman Kodak Co. 7/95-8/04
Group leader, Optical Systems Design Group
Provided technical leadership and actively participated, designed and developed optical systems for color laser printers, laser thermal plate-setters and color proofers, digital cinema projection systems, electronic cameras, optics for LCOS printers and projectors, 3D (autostereoscopic) systems, backlights and illumination control layers for LCD displays, fundus cameras, CR (storage phosphor) medical scanners, dental imaging systems etc. Consulted and supported other research labs and development groups on a variety of optical system design issues.

Tel Aviv University, Department of Physical Electronics 10/94-7/95
Visiting professor
Taught course in optical systems design. R&D work on laser thermal printers for Eastman Kodak.

Engineering Physics Laboratory, Electronic Systems Division, Eastman Kodak Co. 7/90-10/94
Group leader
Optical Systems Design Group. Provided technical leadership and contributed to the design and development of laser thermal imagesetters, flying spot laser printers, optical imaging, projection and illumination systems and diffractive and binary optics, including design, analysis, prototype building, evaluation, manufacturing, and patent protection. Consulted and supported other research labs and development groups on optical system design issues.

Tel Aviv University, Department of Engineering 7/89-7/90


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Visiting professor
Taught course in optical systems design. Developed design and analysis tools for Gaussian beam systems while continuing R&D work on laser printers for Eastman Kodak.

Engineering Physics Laboratory, Electronic Imaging Research Laboratories, Eastman Kodak Co. 1984-89
Group leader
Optical Systems Design Group. Provided technical leadership and contributed to the design and development of laser thermal imagesetters, flying spot laser printers, optical imaging, projection and illumination systems and diffractive and binary optics, including design, analysis, prototype building, evaluation, manufacturing, and patent protection. Consulted and supported other research labs and development groups optical system design issues. Built the optical design group and established two advanced labs, for laser systems and image-forming systems. Coordinated research and development projects with various Kodak lines of business.

Engineering Physics Laboratory, Physics Division, Kodak Research Labs, Eastman Kodak Co. 1982-84
Research scientist
Designed and developed high speed continuous-tone color laser printer for photo-finishing application; high-resolution, large-format continuous-tone laser printer for medical applications; large-format laser storage phosphor scanner; design tools for Gaussian beam optics.

Optical Sciences Center, University of Arizona
Graduate research associate 1977-82
Worked on design of infrared satellite-borne scanner with Prof. William Wolfe; designed subsystems for two-beam, fast laser microscope scanner project for National Institute of Health with Prof. Roland Shack.

Israeli Military Industries, Systems Division 1974-77
Research and development of optical systems
Design and construction of laser systems. Gained experience in atmospheric turbulence effects, diode lasers, laser-guidance systems. Manager of seven-person optics department. Recipient of 1976 Israeli Military Industries award for development of an innovative electro-optical system.

## Military service

Israel Defense Forces
Captain, artillery battery commander

## Educational background

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| Ph.D. Optical Sciences | Optical Sciences Center, University of Arizona<br>Dissertation: "Physically Meaningful Merit Functions for Optical Design Programs." Adviser: Dr. Roland Shack |
| M.Sc. Applied Physics/ Electro-optics | School of Applied Sciences and Technology, Hebrew University of Jerusalem |
| B.Sc., Physics/Mathematics | Hebrew University of Jerusalem |

## Honors

Eastman Kodak Team Achievement Award (Gold) for Phantom Digital Cinema Projector Team
2001: SPIE Fellow
2000: Eastman Kodak Team Achievement Award for "Immersive Experiences Team"
1997-1998: Primetime Emmy for "contributions to the outstanding achievements in engineering development" for Eastman Kodak's Spirit Datacine
1995: Appointed member of Scientific Research Council, comprised of Kodak's 50 leading scientists
1993: Received "Distinguished Inventor" from Kodak Chief Technical Officer
1989: Kodak annual Team Achievement Award for High Definition TV Telecine team

## Affiliations

Optical Society of America: Councilor, Rochester Chapter for 2005-06, chair of Optical Society of America Technical Group:

Optical Systems and Instrumentation for 1993-1994
SPIE: Fellow of the International Society for Optical Engineering
SID: The Society for Information Display

## Advanced Optical Design courses for corporate design teams:

Ocutrex Vision Technologies, LLC, Tulsa, OK, 1/22/2020-1/24/2020
Oculus VR LLC, Redmond, WA, 4/2/2018-4/3/2018
Lumus Ltd., Ness Tziona, Israel, 5/17/2016-5/19/2016
Rafael Advanced Defense Systems, Ltd., Haifa, Israel, 10/20/2013-10/24/2013

# ATTACHMENT

## Publications

David Kessler, Christopher Grabowski, "Volumetric, dashboard-mounted augmented display", the International Optical Design Conference 2017, Denver. Edited by Peter P. Clark, Julius A. Muschaweck, Richard N. Pfisterer, John R. Rogers, Proc. of SPIE-OSA Vol. 10590, July 2017.

David Kessler , "Scan mirrors relay for high resolution laser scanning systems", Proceeding SPIE Volume 9236, Scanning Microscopies, April 2014, Monterey, California.

David Kessler, "An afocal beam relay for laser XY scanning systems," Proc. SPIE Vol. 8215, (2012).

Xiang-Dong Mi, Tomohiro Ishikawa, Andrew Kurtz, David Kessler, "Wide Viewing-Angle Polarizers Having Relaxed Manufacturing Tolerances, SID 06 Digest, paper 45.4, p. 1535-1538, June 2006.

David Kessler, Sujatha Ramanujan, and Yonathan Preiss, "Continuous-Tone Printing Using LCOS", Digest of Technical Papers, SID International Symposium, Vol. XXXVII, Book 1, paper 13-4, p. 174-177, June 2006.

Xiang-Dong, David Kessler, Lee W. Tutt, and Laura Weller-Brophy, "Low Fill-Factor Wire Grid Polarizers for LCD Backlighting," SID 05 Digest, paper 18.4, p. 1004-1007, May 2005.

Seung Ho Baek, Daniel D. Haas, David B. Kay, David Kessler and Kurt M. Sanger, "Multichannel Laser Thermal Printhead Technology", Chapter 14, "Handbook of Optical and Laser Scanning", Gerald F. Marshall, editor, Marcel Dekker, 2004.

Joshua M. Cobb, David Kessler, John A. Agostinelli, and Mark Waldman, "High resolution, auto stereoscopic immersive imaging display using a monocentric optical system", Proc. SPIE Vol. 5006, p. 92-98, May 2003.

Joshua M. Cobb, David Kessler, John A. Agostinelli, "Optical Design of a monocentric auto stereoscopic immersive display", Proc. SPIE Vol. 4832, p. 80-90, International Optical Design Conference, Tucson, Arizona, Dec. 2002.

"Applications of lasers for printing", David Kessler, IEEE Proceedings of the Summer Topical Meeting on Advanced Semiconductor Lasers and Applications, Aug 1997, Montreal, Canada.

E. Wolak, D. Kessler et al., "Integrated Independently Addressable Laser Diodes with 10 W Output Power," proceedings SPIE, February 1997

David Kessler, "Optical Design Issues of Multi-Spots Laser Thermal Printing, Proc. Optics & Imaging in the Information Age," IS&T/OSA, p. 215-219, October 1996.

David Kessler and Roland V. Shack, "YY Diagram, a powerful optical design method for laser systems," Applied Optics, **31**, No. 15, 2692-2702 (1992).

Andrew F. Kurtz and David Kessler, "Optical scanning system for a CCD telecine for HDTV," Proceeding SPIE 1448, pp 191-205 (1991).

D. Kessler et al., "High Performance CCD Telecine for HDTV" SMPTE Journal, Oct. 1990.

V. Files and D. Kessler, editors. "Optical Hard Copy and Printing Systems" Proc. SPIE Vol. 1254 (1990).

K. L. Yip, D. Kessler and S. Dally, "Modulator-induced streaking artifact in laser film printer images," Proceeding SPIE **1254**, pp 33-41 (1990).

D. DeJager, "High Resolution Laser Writer", in Hard Copy Output, L. Beiser, ed., Proc. SPIE 1079 (1989).

J. C. Owens, C. P. Brophy, and D. Kessler, "Design of a compact diode laser color printer," in Hard Copy Output, L. Beiser, ed., Proc. SPIE 1079 (1989).

R. R Firth, D. Kessler, E. Muka, N. Naor and J. C. Owens, "A Continuous-Tone Laser Color Printer," J. of Imaging Technology, **14:3** 78 (1988).

D. Kessler and R. V. Shack, "First Order Design of Laser Systems with the YYbar Diagram," J. Opt. Soc. Am. A. **1:12**, 1219 (1984).

Kessler, and R.V. Shack, "Image Quality Criteria in the Presence of Moderately Large Aberrations," J. Opt. Soc. Am., **78:8,** 1105, (1982).

Shoemaker R. L., P. H. Bartels, D. Hillman, J. Jonas, D. Kessler, R. Shack and D. Vukobratovitch, "An Ultrafast Laser Scanner Microscope for Digital Image Analysis," IEEE Transactions on Biomedical Engineering, **29**, 82 (1982).

R.V. Shack, P.H. Bartels, D. Kessler, et al., "Ultrafast Laser Scanner Microscope," Analytical and Quantitative Cytology Journal, **4**, 158, (1982).

P. H. Bartels, R. V. Shack, D. Kessler, et al., "Ultrafast Laser Microscope: Design and Construction," Analytical and Quantitative Cytology Journal, **3**, No. 1, (1981).

D. Kessler, and R. Shack, "Dynamic Optical Testing of a High-Speed Polygon," Applied Optics, **20**, 1015 (1981).

## Presentations

"Symmetrical Scanning Microscope with Large FOV and large NA", David Kessler, OSA Biophotonics Congress: Biooptics Optics, Fort Lauderdale April 21, 2020 (via Zoom).

"Volumetric, dashboard-mounted augmented display", David Kessler, Chris Grabowski*,* the International Optical Design Conference, July 7, 2017, Denver, CO.

"Pupil-Expanded Biocular Volumetric Display", David Kessler, Chris Grabowski*,* SID Vehicle Displays and Interfaces 2015, October 22-23, 2015, Dearborn, MI.

"Scan mirrors relay for high resolution laser scanning systems", SPIE Conference- Scanning Microscopies, April 13, 2014, Monterey, CA.

"Image Quality Issues: the optical designer point of view", invited talk, ICIS 2014, May 2014, Dan Panorama Hotel, Tel Aviv, Israel.

"Optics of Near to Eye Displays," invited talk, 4Oasis 2013; International Meeting on Optical Engineering and Science in Tel Aviv, Israel, February 19, 2013.

"Patenting your Optical Ideas in the Corporate World", OSA Rochester, NY Section, September 30, 2008.

"High Resolution Auto Stereoscopic Immersive Display Using a Monocentric Optical System", Josh M. Cobb, David Kessler and John A. Agostinelli, OSA Rochester, NY Section, January 28, 2003.

"Applications of diode Lasers in Printing and Graphic Arts", Laser Marketing Seminar 1998, Photonics West January 28, 1998.

"Lasers and Optics for Digital Printing Systems", David Kessler, CLEO / QELS 97, Baltimore, MD.

"Integrated Independently Addressable Laser Diodes with 10W Output Power", E. Wolak et al, SDL, S. H. Baek, D. Kessler et al, Eastman Kodak Company, SPIE Photonics West, February 10-14, 1997, San Jose, CA. Also: Program committee and session chair, same conference.

"Optics in Imaging Systems", OSA Executive Forum, OSA and LEOMA, Rochester, NY, October 21, 1996.

"Optics in Imaging Systems", Workshop on Optical Sciences & Engineering and Manufacturing, National Research Council, Irvine, CA, October 11-13, 1995.

"Optics of Laser Printers", Tutorial, OSA Annual Meeting, Toronto, October 7, 1993.

Chair of the SPIE conference on Optical Hard Copy and Printing Systems, 13-14 February 1990, Santa Clara, CA.
Session Chairman for "Major Subsystems and Controls for Hardcopy Output" SPIE Hard Copy Output Conference January 1989.

"Optical Design Aspects of Hard Copy Output Systems" presented at IBM Watson Research Center, March 10, 1989.

"Laser Printers," presented at Chiba University, Tokyo, Japan, December 2, 1986.

"Color Laser Printer: Optical Design," presented at the 3rd International Congress on Advances in Non-Impact Printing Technologies, San Francisco, August 1986.

## 105 U.S. patents issued:

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| 3D auto stereoscopic systems: | **7,111,943; 6,940,645; 6,871,956; 6,869,183; 6,834,961; 6,752,498; 6,511,182; 6416181.** |
| HUDs and AR/VR: | **11,353,711; 11,340,451; 11,181,747; 11,112,611; 10,816,795**; **10,061,129; 9,740,004; 8,094,377; 8,215,776; 522,474.** |
| LC and OLED Displays**:** | **7,892,381; 7,618,178; 7,548,676; 7,334,897;7,295,262; 7,292,760; 7,229,199; 7,198,373; 7,149,393; 7,024,082**. |
| Volumetric displays: | **8,441,733; 9,740,004.** |
| Display films: | **7,581,867; 7,359,020; 6,997,595; 7,160,017.** |

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| Digital camera optics: | **9,654,675; 7,616,881; 7,298,970; 6,937,283**; **5,684,293.** |
| Digital cinema and projectors: | **7,559,654; 7,184,115; 6,954,245; 6,909,473; 6,897,926; 6,676,269; 6,585,378.** |
| Printing with LCOS: | **6,980,321; 6,930,797; 6,407,766; 6,215,547.** |
| Laser thermal printers: | **6,211,897; 5,923,475; 5,854,651; 5,745,153; 5,619,245; 5,475,416.** |
| 3D lenticular systems: | **6,252,621**; **6,191,802**. |
| Flying spot laser printers: | **6,515,782; 6,069,680; 5,294,943; 5,278,691; 5,237,348; 5,214,441; 5,151,810; 5,023,448; 5,018,805; 4,982,206; 4,921,320; 4,796,962; 4,759,593; 4,728,965; 4,651,170; 4,616,132.** |
| CCD scanners: | **5,255,114; 5,221,975; 5,025,313, 5,012,346.** |
| Novel optical systems: | **7,414,784** (wire grid polarizers); **6,863,404** and **6,820,982** (imaging on curved diffuser); **6,734,889** (Linear grating-based printer); **6,304,315** (Offner film copier**); 6,094,210** & **5,241,523** (auto focus systems); **5,105,297** (optical mount); **5,002,365** (beam splitter); **4,868,383** (linear integrating cavity). |
| Laser optical systems: | **11,156,817** (large field laser scanning microscope**); 8,531,750** (beam relay); **8,274,720** (beam relay**); 5,610,753** (laser optics with reduced focus sensitivity**); 5,533,152** (laser fiber coupling); **4,588,269** (beam shaper). |
| Medical systems: | **7,296,894** (Fundus camera); **4,991,918** (Computed radiography scanners). |
| UV wide format systems: | **6,988,811; 6,943,930; 6,874,899.** |
| Polarized eyewear: | **8,177,358; 7,771,045; 7,466,484.** |
| Lithography: | **10.908,504** |
| LEDs illumination: | **10.989,390 (LEDs folded high efficiency lamp)** |

## Expert witness testimonies

Expert witness for the defendant 3Shape vs. the plaintiff Align Technologies at the ITC court in Washington, DC regarding certain confocal microscopy technology for dentistry. Included depositions, written and video and expert witness reports and testimony at court on November 7, 2018.

Expert witness for the defendant MasterImage vs. the plaintiff RealD at the ITC court in Washington, DC regarding certain 3D cinema projection systems. Included depositions; written, video and expert witness reports and testimony at court on September 17, 2015.