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Present Position

Senior Scientist for Vision Research, NASA Ames Research Center

Date of Birth

November 4, 1951 (Washington, D.C.)

Education

Columbia University, Psychology, 1969-1973
University of Pennsylvania, Psychology, Ph.D., 1973-1977

Previous Positions

Senior Research Associate, Stanford University	1980 – 1982
NIH Research Fellow, Cambridge University, England	1977 – 1980

Research Interests

Visual neuroscience and psychophysics
Computational models of visual function
Applications of vision science to human factors, displays, imaging technology, and computer vision

Editorial Boards

Founder, Editor-in-Chief, Journal of Vision	2000 – 2012
Editor, ACM Transactions on Applied Perception	2012 –
Editor, Displays: Technology and Applications	1993 –
Editor, Journal of Intelligent Systems	1990 –
Editor, Journal of Mathematical Psychology	1988 – 2003
Editor, Optics Express	1999 – 2002
Editor, Visual Neuroscience	1992 – 1996

Awards and Fellowships

Distinguished Service Award, Assoc. for Research in Vision and Ophthal.	2013
Presidential Rank Award, President of the United States	2011
Fellow Award, Society for Information Display	2010
Fellow Award, Assoc. for Research in Vision and Ophthalmology	2010
Special Recognition Award, Assoc. for Research in Vision and Ophthalmology	2008
Otto Schade Award, Society for Information Display	2007
Fellow Award, Optical Society of America	1993
NASA Ames Associate Fellow	1993 – 96
H. Julian Allen Award	1990
NASA Space Act Award	1989, 1997
NIH Postdoctoral Fellowship	1977 – 1980
Sigma Xi Prize for Graduate Research	1976

Professional Societies

Optical Society of America – Fellow
Society for Information Display – Fellow
Association for Research in Vision and Ophthalmology - Fellow
Vision Sciences Society
International Society for Optical Engineering

Conference Committees

Symposium on Applied Perception	2011 –
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Human Vision and Electronic Imaging	1998 –
European Visual Information Processing conference	2013 –
International Conference on Image Processing	2003 – 2008
IASTED International Conference on Human-Computer Interaction	2009
Chair, European Conference on Visual perception	2001
Program Committee, European Conference on Visual perception	2000
Optical Society of America, Vision Technical Group, Chair	1996 – 1998
Program Committee, Assoc. for Research in Vision and Ophthalmology	1990 – 1992
Program Committee, Society for Information Display	1989 – 1996
National Research Council, "Visual factors in elect. image communications"	1991
National Research Council, Conference Chair for "Visual Search"	1990
National Research Council, Panel on "Night Blindness"	1985 – 1987
National Research Council, Panel on "Pilot Performance Models"	1987 – 1989

Committees

Society for Information Display, Honors and Awards Committee	2013 –
International Committee for Display Measurement, Vice Chair	2007 –
International Commission on Illumination (CIE)	2006 –
Optical Society of America, Tillyer Award, Chair	2004 – 2006
Video Electronics Standards Association (VESA)	2006 – 2007
IEEE Video Compression Measurements Subcommittee (IEEE G-2.1.6)	1998 – 2005
Video Quality Experts Group (VQEG)	1997 – 2004
NASA Ames Science Advisory Council	1994 –
National Research Council, Committee on Vision	1987 – 1992
NASA Ames Strategy and Tactics Committee	1985 – 1989

Publications

Journal Articles

- Watson, A. B. (2014). A formula for human retinal ganglion cell receptive field density as a function of visual field location. *Journal of Vision*, in press.
- Watson, A. B. (2013). A formula for the mean human optical modulation transfer function as a function of pupil size. *Journal of Vision*, 13(6), <http://journalofvision.org/13/6/18/>.
- Watson, A. B. (2013). High Frame Rates and Human Vision: A View Through the Window of Visibility. *SMPTE Motion Imaging Journal*, 122(2), 18-32, <http://journal.smpte.org/content/122/2/18> .
- Watson, A. B., & Ahumada, A. J. (2012). Modeling acuity for optotypes varying in complexity. *Journal of Vision*, 12(10), 1-19, <http://journalofvision.org/12/10/19/>.
- Watson, A. B., & Yellott, J. I. (2012). A unified formula for light-adapted pupil size. *Journal of Vision*, 12(10), <http://journalofvision.org/12/10/18/>.
- Watson, A. B. (2012). Perimetric complexity of binary digital images: Notes on calculation and relation to visual complexity. *Mathematica Journal*, 14, <http://www.mathematica-journal.com/2012/02/perimetric-complexity-of-binary-digital-images/>.
- Watson, A. B., & Ahumada, A. J. (2011). Blur Clarified: A review and synthesis of blur discrimination. *Journal of Vision*, 11(5), 1-23. <http://journalofvision.org/11/5/10/>.
- Watson, A. B. (2011). It seemed like a good idea at the time: A brief history of Journal of Vision. *Journal of Vision*, 11(5), 11(5), 1-12, <http://journalofvision.org/11/5/ii/>.
- Watson, A. B. (2010). Display motion blur: Comparison of measurement methods. *Journal of the Society for Information Display*, 18(2), 179-190.
- Watson, A. B. (2009). Comparing citations and downloads for individual articles. *Journal of Vision*, 9(4):i, 1-4, <http://journalofvision.org/9/4/i/>, doi:10.1167/9.4.i.
- Watson, A., Ramirez, C. V., & Salud, E. (2009). Predicting visibility of aircraft. *PLoS ONE*, 4(5), e5594, <http://dx.doi.org/10.1371/journal.pone.0005594>.
- Watson, A. B., & Ahumada, A. J., Jr. (2008). Predicting visual acuity from wavefront aberrations. *Journal of Vision*, 8(4), 1-19, , <http://journalofvision.org/8/4/17/>, doi:10.1167/8.4.17.
- Watson, A. B. (2007). The spatial standard observer: A new tool for display metrology. *Information Display*, 23(1), 12-15.

- Watson, A. B. (2007). The numbering of things. *Journal of Vision*, 7(1), 1-1, <http://journalofvision.org/7/1/i/>, doi: 10.1167/7.1.i.
- Watson, A. B. (2007). Measuring demand for online articles at the Journal of Vision. *Journal of Vision*, 7(7):i, 1-3, <http://journalofvision.org/7/7/i/>, doi:10.1167/7.7.i.
- Fiske, T. J., Silverstein, L. D., Hodgson, S., & Watson, A. B. (2007). Visual quality of high-contrast projection screens part i: Visibility of screen-based artifacts and noise. *Journal of the Society for Information Display*, 15(6), 409-419.
- Liu, Z., Karam, L. J., & Watson, A. B. (2006). JPEG2000 encoding with perceptual distortion control. *IEEE Transactions on Image Processing*, 15(7), 1763-1778..
- Watson, A. B., & Ahumada, A. J., Jr. (2005). A standard model for foveal detection of spatial contrast. *Journal of Vision*, 5(9), 717-740, <http://journalofvision.org/5/9/6/>, doi:10.1167/5.9.6.
- Watson, A. B. (2001). Welcome to the Journal of Vision. *Journal of Vision*, 1(1):i, i, <http://journalofvision.org/1/1/i/>, doi:10.1167/1.1.i.
- Watson, Andrew B., Hu, James & McGowan, John F, III. (2001). Digital video quality metric based on human vision. *Journal of Electronic Imaging* 10(1), 20-29.
- Watson, A. B. (2000). Visual detection of spatial contrast patterns: Evaluation of five simple models. *Optics Express* 6(1), 12-33.
- Barth, E. & Watson, A. B. (2000). A geometric framework for nonlinear visual coding. *Optics Express* 7(4), 155-165.
- Solomon, J. A., Watson, A. B. & Morgan, M. J. (1999). Transducer model produces facilitation from opposite-sign flanks. *Vision Res* 39(5), 987-92.
- Watson, A. B. (1998). The search for optimal visual stimuli. *Vision Research* 38(11), 1619-1621.
- Watson, A. B. & Solomon, J. A. (1997). A model of visual contrast gain control and pattern masking. *Journal of the Optical Society A*, 14, 2379 - 2391.
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- Eckstein, M. P., Ahumada, A. J., Jr. & Watson, A. B. (1997). Visual signal detection in structured backgrounds. II. Effects of contrast gain control, background variations and white noise. *Journal of the Optical Society A*, 14(9), 2406-2419.
- Watson, A. B. & Solomon, J. A. (1997). Psychophysica: Mathematica notebooks for psychophysical experiments. *Spatial Vision*, 10(4), 447-466.
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- Watson, A. B. & Turano, K. A. (1995). The optimal motion stimulus. *Vision Research* 35(3), 325-336.
- Watson, A. B. (1994). Image compression using the Discrete Cosine Transform. *The Mathematica Journal*, 4(1), 81-88.
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- Watson, A. B. (1992). Transfer of contrast sensitivity in linear visual networks. *Visual Neuroscience* 8, 65-76.
- Watson, A. B. (1990). Perceptual-components architecture for digital video. *Journal of the Optical Society of America A* 7(10), 1943-1954.
- Watson, A. B. (1990). Optimal displacement in apparent motion and quadrature models of motion sensing. *Vision Research* 30(9), 1389-1393.
- Watson, A. B. (1990). Gain, noise, and contrast sensitivity of linear visual neurons. *Visual Neuroscience* 4, 147-157.
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- Watson A. B. (1987) The cortex transform: Rapid computation of simulated neural images. *Computer Vision, Graphics, and Image Processing* **39**(3), 311-327.
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- Watson A. B. and Poirson A. (1986) Separable two-dimensional discrete Hartley transform. *Journal of the Optical Society of America*, **3**(12), 2001-2004.
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- Ahumada A. J., Jr. and Watson A. B. (1985) Equivalent-noise model for contrast detection and discrimination. *Journal of the Optical Society of America A*, **2**, 7, 1133-1139.
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- Watson A. B. (1982) Derivation of the impulse response: Comments on the method of Roufs and Blommaert. *Vision Research* **22**, 1335-1337.
- Watson A. B. (1982) Summation of grating patches indicates many types of detector at one retinal location. *Vision Research* **22**, 17-25.
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- Watson A. B. & Nachmias J. (1980) Summation of asynchronous gratings. *Vision Research* **20**, 91-94.
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- Watson A. B. & Nachmias J. (1977) Patterns of temporal interaction in the detection of gratings. *Vision Research* **17**, 893-902.

Books and Book Chapters

- Watson, A. B. (2010). Human Vision. In *Human Integration Design Handbook* (Vol. NASA/SP-2010-3407): NASA.
- Watson, A. B., & Silverstein, L. D. (2010). Visual Displays, In *Human Integration Design Handbook* (pp. 761-822): NASA.
- Watson, A. B., ed. (1993). *Digital images and human vision*. Cambridge MA: MIT Press.
- Watson, A. B. & A. J. Ahumada, J. (1994). A hexagonal orthogonal-oriented pyramid as a model of image representation in visual cortex. In M. M. G. a. G. K. Knopf (Ed.), *Neuro-vision systems: principles and applications* New York: IEEE Press.

- Watson, A. B. (1991). Cortical Algotechure. In C. B. Blakemore (Ed.), *Vision: Coding and efficiency* Cambridge: Cambridge University Press.
- Watson, A. B. (1991). Neural contrast sensitivity. In M. S. Landy, & J. A. Movshon (Ed.), *Computational models of visual processing* (pp. 95-107). Cambridge: MIT Press.
- Watson, A. B. (1991). Multidimensional pyramids in vision and video. In A. Gorea (Ed.), *Representations of vision: trends and tacit assumptions in vision research* (pp. 17-26). Cambridge: Cambridge University Press.
- Watson, A. B. (1990). Models in early vision. In J. I. Elkind, S. K. Card, J. Hochberg, & B. M. Huey (Ed.), *Pilot performance models for computer-aided engineering* (pp. 61-74). Boston: Academic Press.
- Watson, A. B. (1989) Toward a model-based human factors. In W. B. Rouse (Ed.), *Advances in man-machine systems research*, vol. 5, (pp. 229-279). Greenwich, Connecticut: JAI Press.
- Watson A. B (1987) The role of vision models in human factors. *Night Vision* Washington D.C.: National Academy of Sciences Press.
- Watson A. B. (1987) The ideal observer as a modeling tool. *Frontiers of visual science: Proceedings of the 1985 Symposium*. Washington D.C.:National Academy Press, 32-37.
- Watson, A. B. (1986). Temporal Sensitivity. In K. Boff, L. Kaufman, & J. Thomas (Ed.), *Handbook of Perception and Human Performance* New York: Wiley.
- Watson A. B. (1983) Detection and recognition of simple spatial forms. In *Physical and biological processing of images*. Edited by O. J. Braddick and A. C. Slade. Berlin: Springer-Verlag. Also published as *NASA Technical Memorandum 84353* .
- Watson, A. B., & Ahumada, A. J., Jr. (1983). A look at motion in the frequency domain. In J. K. Tsotsos (Ed.), *Motion: Perception and representation* (pp. 1-10). New York: Association for Computing Machinery. Also published as *NASA Technical Memorandum 84352* .

Patents

- Watson, A.B. and Ahumada, A.J. (2014) *Visible motion blur* , US Patent 8,675,922.
- Watson, A.B. and Ahumada, A.J. (2013) *Prediction of visual acuity from wavefront aberrations* , US Patent 8,408,707.
- Watson, A. B. (2012). *Spatial standard observer*, US Patent 8,139,892.
- Watson, A. B. (2012). *Video acuity measurement system*. US: NASA, filed
- Watson, A. B. (2010). *Spatial standard observer*, US Patent 7,783130.
- Watson, A. B. (2002). *Method and apparatus for evaluating the visual quality of processed digital video sequences*, US Patent 6,493,023.
- Watson, A. B. (2000). *Efficient adaptive estimation of sensory scales* NASA Ames Research Center Disclosure of Invention.
- Watson, A. B. (1997). *Image data compression having minimum perceptual error*. US Patent 5,629,780.
- Watson, A. B. (1995). *Image data compression having minimum perceptual error*. US Patent 5,426,512.

Standards

- NASA/SP-2010-3407 the Human Integration Design Handbook (HIDH) http://ston.jsc.nasa.gov/collections/TRS/_techrep/SP-2010-3407.pdf. Principal author of sections on “Human Vision” and “Visual Displays.”
- NASA-STD-3001, Space Flight Human System Standard Volume 2, Human Factors, Habitability, and Environmental Health. Principal author of sections relating to visual human factors.
- International Committee on Display Metrology, Display Measurement Standard (ICDM-DMS). (2013) Principal author of sections on motion blur, display uniformity, and display flicker.
- Watson, A. B. (2005). *Draft standard for the subjective measurement of visual impairments in digital video using a just noticeable difference scale* (IEEE Draft Standard No. IEEE P1486/D07): IEEE G-2.1 Audio-Video Techniques Committee, G-2.1.6 Subcommittee on Video Compression Measurements of the IEEE Broadcast Technology Society.

Technical Reports & Conference Proceedings

- Ahumada, A. J., & Watson, A. B. (2013). Visible contrast energy metrics for detection and discrimination. Proceedings of the SPIE, 8651, 86510D-86510D, <http://dx.doi.org/10.1117/12.2009383>.

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- Watson, A. B., & Ahumada, A. J. (2011). 64.3: Flicker Visibility: A Perceptual Metric for Display Flicker. SID Symposium Digest of Technical Papers, 42(1), 957-959, <http://dx.doi.org/10.1889/1.3621499>.
- Watson, A. B. (2010). Visible Motion Blur: A perceptual metric for display motion blur. Society for Information Display Digest of Technical Papers.
- Tourancheau, S., Brunnström, K., Watson, A. B., & André, B. (2010). Evaluation of Blur Edge Time as a predictor of perceived motion blur. Society for Information Display Digest of Technical Papers.
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- Watson, A. B., Taylor, M. & Borthwick, R. (1997). Image quality and entropy masking Proceedings, Human Vision, Visual Processing, and Digital Display VIII, San Jose, CA, SPIE, Bellingham, WA, 3016, pp. 2-12.
- Watson, A. B. (1997). Compressing image data with minimal perceptual errors. NASA Tech Briefs 21(1), 73-74.
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- Watson, A. B., Yang, G. Y., Solomon, J. A. & Villasenor, J. (1996). Visual thresholds for wavelet quantization error. In B. Rogowitz, & J. Allebach (Ed.), *Human Vision and Electronic Imaging* (pp. 382-392). The Society for Imaging Science and Technology.
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- Watson, A. B., & Ahumada, A. J., Jr. (1995). Preservation of photometric accuracy in ICT-compressed imagery. NASA Technical Memorandum.
- Ahumada, A. J., Jr., Watson, A. B. & Rohaly, A. M. (1995). Models of human image discrimination predict object detection in natural backgrounds Proceedings, Human Vision, Visual Processing, and Digital Display VI (SPIE Proceedings v. 2411), in press.
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Selected Invited Presentations

Vision models and visual quality, Seoul National University, Seoul, South Korea, February 2013.
Vision models and visual quality, Trinity College, Dublin, Ireland, April, 2012.
Video Acuity: A Metric to Quantify the Effective Performance of Video Systems, Optical Society of America, Imaging Systems Applications Topical Meeting, July 2011.
Vision models and visual quality, Quality of Multimedia Experience (QOMEX) Meeting on June 21, 2010, Trondheim Norway.
Metrics for predicting visual acuity, Wavefront Congress, Alicante, Spain, March 4-7, 2009.
Developing Human Vision Models for Video Compression, Display Design, and Other Visual Technologies, Google, Inc., Mountain View, CA, March 2006.
Eye-Robot: A standard observer for visual technology, Electronic Imaging, San Jose, CA, January 17, 2005
Human optical image quality and the Spatial Standard Observer, OSA Fall Vision Meeting, Rochester, NY, October, 2004
The challenge of video quality estimation, 37th Annual IEEE Asilomar Conference on Signals, Systems, and Computers, 11/10/03.
Vision Science and Technology at NASA Ames Research Center, American Academy of Optometry Annual Meeting, San Francisco, CA, 11/98.
Image Quality, Applied Vision Association, Keynote Speech, Dundee, Scotland, 4/10/97
Perceptual Modeling of Image Quality, Integrated Media Center, Univ. of Southern California, 2/97
Image quality and vision models, Optical Society of America Annual Meeting, 11/96.
Perceptual aspects of image compression. Optical Society of America Annual Meeting, 11/94.
Digital video and human visual perception. NSF Workshop on Digital Video, UC Irvine, 12/93.
Vision models for display design. EuroDisplay 93: The 13th International Display Research Conference Seminar and Exhibition, Strasbourg, France: 9/93.
Vision Models for information display. Society for Information Display, Boston, MA, 5/92.
Models of human vision. SPIE-The International Society for Optical Engineering Symposium on Human Vision, Visual Processing, and Digital Display, 2/92.
Image decomposition in human vision. Optical Society of America Annual Meeting, 11/91.
Perceptual approaches to image coding. National Research Council Workshop on Visual Factors in Electronic Image Communications, Woods Hole, MA, 7/91.
Vision Science and Technology: designing for the minds eye. Dedication Symposium for the NASA Human Performance Research Laboratory 6/90.
Multidimensional pyramids in vision and video. Symposium on Visual Pyramids and Neural Networks, 13th European Conference on Visual Perception, Paris 9/90.
Mathematica and Vision Science. First Annual Mathematica Conference, Redwood City, CA, 1/90.
Spatiotemporal contrast sensitivity of linear visual neurons. 12th European Conference on Visual Perception, Haifa, Israel, 9/89.
Neural Contrast sensitivity, Cold Spring Harbor Laboratory Symposium on Computational models in visual processing, 6/89.
Neural codes, receptive fields, and visual representations. Optical Society of America Topical Meeting on Applied Vision, San Francisco, CA, 7/89.
Neural Image Codes. at NASA International Workshop on Visual Information Processing for Television and Telerobotics, Williamsburg, VA, 5/89.
Receptive fields and visual representations. SPIE Meeting on "Human Vision, Visual Processing, and Digital Displays" 1/89.
Modeling character legibility, Society for Information Display, Baltimore MD, 5/89
Human visual representation of spatial imagery. Tenth European Conference on Visual Perception, Varna, Bulgaria, September, 1987.

Hypothetical image codes in human vision. Symposium on Vision: Coding and Efficiency, Cambridge, England, September, 1987.

Efficient image compression based on human vision models. Rank Prize Funds Symposium on Efficiency in Human and Machine Vision, London, England, December, 1986.

Efficient image representation and the perception of shape. Rochester Center for Visual Science, Symposium on *Computational Vision*, University of Rochester, June, 1986.

The ideal observer concept in models of human vision. National Research Council, Committee on Vision, Symposium on *Frontiers of Visual Science*, Washington, DC, December, 1985.

The role of models in human factors. National Research Council, Committee on Vision, Conference on Night Vision, Brooks AFB, October, 1985.

Computational experiments in spatial vision. Annual meeting of the Optical Society of America, San Diego, CA, October, 1984.

Selected Colloquia

Seoul National University, Seoul, South Korea

Trinity College, Dublin, Ireland

Stanford University, Stanford, CA

University of California, San Diego, CA

University of California, Santa Barbara, CA

University of California, Berkeley, CA

University of California, Santa Cruz, CA

University of California, Irvine, CA

University of Southern Calif., Los Angeles, CA

Cambridge University, Cambridge, England

Oxford University, Oxford, England

University of Sussex, Brighton, England

University of Rochester, Rochester, NY

New York University, New York, NY

RCA Sarnoff Research Labs, Princeton, NJ

Smith-Kettlewell Institute, San Francisco, CA