

BIOGRAPHICAL SKETCH

NAME Michael David Abràmoff		POSITION TITLE Professor	
eRA COMMONS USER NAME mabramoff			
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	YEAR(s)	FIELD OF STUDY
University of Amsterdam, Netherlands	M.S.	1982-1988	Medicine
University of Amsterdam	M.S.	1987-1989	Biomedical Informatics
University of Amsterdam	M.D.	1993-1994	Medicine (Internship)
University Hospital of Utrecht	Residency	1995-1999	Ophthalmology
Vrije Universiteit University Hospital, Amsterdam, Netherlands	Retinal Fellowship	1999-2000	
University of Utrecht	Ph.D.	1997 - 2001	Biomedical Imaging
Vrije Universiteit, Amsterdam, Netherlands	Postgraduate Degree	2002 - 2003	Clinical Epidemiology

A. Personal Statement

1. Experience and expertise in retinal image analysis, development of novel algorithms and approaches for automated detection, segmentation, and interpretation of 2D and 3D images
2. Fellowship trained retinal specialist
3. Expertise in quantitative approaches to medical imaging, including automated discovery and quantification of retinal phenotype-genotype associations.
4. Experience with application of retinal image analysis to diabetic retinopathy, macular degeneration, glaucoma, retinopathy or prematurity, malarial retinopathy
5. Proven proficiency to contribute to interdisciplinary basic image analysis, translational and clinical research as shown by numerous US and international ongoing collaborative projects.

B. Positions

- 2011 - President, IDx LLC, Iowa City, Iowa
- 2012 - Professor, Ophthalmology & Visual Sciences, Carver College of Medicine; Electrical and Computer Engineering, and Biomedical Engineering, College of Engineering, University of Iowa
- 2013 - Advisor, X-Prize Foundation, Playa Vista, CA
- 2011 - ARVO annual meeting program committee (Chair 2013-)
- 2011 - Mentor, Medical Scientist Training Program, University of Iowa
- 2010 - Iowa Academy of Ophthalmology Medical Services Committee
- 2009 - Associate Director, Department of Veterans' Affairs Center of Excellence for Prevention and Treatment of Visual Loss
- 2008 - Editor, IEEE Transactions on Medical Imaging
- 2008 - 2012 Associate Professor (tenure), Ophthalmology and Visual Sciences, Electrical and Computer Engineering, Biomedical Engineering, University of Iowa
- 2004 - Retinal specialist, Eye Service, Veterans' Affairs Medical Center Iowa City, Iowa
- 2004 - 2008 Assistant Professor, Ophthalmology & Visual Sciences, Electrical and Computer Engineering, Iowa
- 2003 - 2004 Research Fellow, Ophthalmology and Visual Sciences, University of Iowa, IA
- 2001 - present Director and Founder, EyeCheck project, Amsterdam, Netherlands
- 2001 - 2006 Faculty, Image Sciences Institute, University of Utrecht, Netherlands
- 2001 - 2004 Universitair Medisch Specialist (faculty), Department of Ophthalmology, VU University Hospital, Amsterdam, Netherlands
- 1991 - 1993 Director of Research and Development, Prodix SA, Paris, France
- 1990 - 1991 Postdoctoral Research Fellow, RIKEN neural networks research lab, Wako-shi, Saitama, Japan

Honors

- 2013 Young Investigator Award, Macula Society
- 2011 President's Innovation Award, American Telemedicine Association
- 2010 Senior Member, IEEE
- 2009 Visiting Professor, Moran Eye Center, University of Utah, Salt Lake City, UT
Visiting Professor, Fraunhofer Institute, Erlangen, Germany
Visiting Professor, Department of Ophthalmology, Univ PA Medical College, Pittsburgh, PA
- 2008 Annual Medical Education Award, University of Iowa
- 2007 - Member, Macula Society

- 2004 - 2010 Member, Committee on Medical Information Technology of the American Academy of Ophthalmology
- 2004 P.J. Leinfelder Award, "Functional imaging of the retina," Best seminar delivery by fellow. Sponsored by Department of Ophthalmology and Visual Sciences, University of Iowa
- 2003 Binkhorst Award, "Objective Measurement of Motion in the Orbit," Highest research merit from the Netherlands Ophthalmologic Society. Sponsored by Netherlands Ophthalmologic Society.
- 2002 3M-Jonkers Award and Medal of Honor, "Rectus extraocular muscle paths and decompression surgery for Graves orbitopathy: mechanism of motility disturbances," Best scientific publication over preceding 3 years. Sponsored by 3M-Jonkers Foundation.
- 1997 F.P. Fischer Foundation Award, Netherlands
- 1990 Peter Reichertz Memorial Prize for best young researcher, from European Federation for Medical Informatics.
- 1989 Postdoctoral Fellowship Award, Science and Technology Agency (STA), Ministry of Education, Tokyo, Japan

Patents (and 6 patent applications)

- 2009 Automatic detection of red lesions from digital color fundus photographs. US Patent No 7474775
- 2010 Methods and systems for optic nerve head segmentation. US Patent No 7712898
- 2012 Optimal registration of multiple deformed images using a physical model. US Patent No 8194936
- 2012 Methods for Determining Optimal Features for Classifying Patterns or Objects in Images. US Patent No 8340437
- 2013 System and Methods for Image Segmentation in N-dimensional space. US Patent No 8358819
- 2014 Hybrid Laser Ophthalmoscope. US Patent No. 8616702

B. Selected Peer-Reviewed Publications (out of 180)

1. Garvin MK, Lee K, Bruns TL, **Abràmoff MD**, Sonka M, Kwon YH. Reproducibility of SD-OCT-based ganglion-cell-layer thickness in glaucoma using two different segmentation algorithms. *Invest Ophthalmol Vis Sci*, 2013. IN PRESS [IOVS-13-12131R1]
2. Mullins RF, **Abràmoff MD**, Stone EM. Letter to the Editor: Outer retinal structure in Best vitelliform macular dystrophy. *J Am Acad Ophthalmol* 2013. IN PRESS. [OPH13-1683]
3. Helmchen L, Lehmann H, **Abràmoff MD**. Automated detection of retinal disease. *Am J Managed Care* 2013. IN PRESS [AJMC-2013-05-0170.R1]
4. Zhang L, Sonka M, Russell S, Folk J, **Abràmoff MD**. Quantifying disrupted outer retina-subretinal layer in SD-OCT images in choroidal neovascularization. *Invest Ophthalmol Vis Sci*, 2014; 55(4):2329-2335. [EPub 2014/02/27 PMID 24569576] (*Research Highlight: Kiernan CL, Kiernan DF. Advancing OCT Algorithmic Standardization. Invest Ophthalmol Vis Sci. 2014 Apr 11; 55(4):2336. [doi: 10.1167/iovs.14-14288 PMID: 24729551].*)
5. Joshi V, Reinhardt J, Garvin M, **Abràmoff MD**. Automated method for identification and artery-venous classification of vessel trees in retinal vessel networks. *PLoS ONE* 2013;9(2): e88061. doi:10.1371/journal.pone.0088061 [PubMed ID: 24533066; PubMed Central 3922768 EMID:fa523f2e8f5a3e08]
6. Sohn EH, Khanna A, Tucker BA, **Abràmoff MD**, Stone EM, Mullins RF. Structural and biochemical analyses of choroidal thickness in human donor eyes. *Invest Ophthalmology Vis Sci*, 2014. 55(3):1352-1360. [EPub 2014/02/13 PMID 24519422]
7. **Abràmoff MD**, Mullins RF, Lee K, Hoffmann JM, Sonka M, Critser DB, Stasheff SF, Stone EM. Human photoreceptor outer segments shorten during light adaptation. *Invest Ophthalmol Vis Sci*. 2013;54(5):3721-3728. [PMID 23633665; doi: 10.1167/iovs.13-11812; PMCID 3668803]
8. Sohn EH, Chen JJ, Lee K, Niemeijer M, Sonka M, **Abràmoff MD**. Reproducibility of diabetic macular edema estimates from SD-OCT is affected by the choice of image analysis algorithm. *Invest Ophthalmol Vis Sci*. 2013;54(6):4184-4188. [PMID 23696607; doi: 10.1167/iovs.12-10420].
9. Lee K, Sonka M, Kwon YH, Garvin MK, **Abràmoff MD**. Adjustment of the retinal angle in SD-OCT of glaucomatous eyes provides better inter-visit reproducibility of peripapillary RNFL thickness. *Invest Ophthalmol Vis Sci*, 2013;54(7):4808-4812. [PMID 23788372 doi: 10.1167/iovs.13-12211]
10. Christopher M, Scheetz TE, Mullins RF, **Abràmoff MD**. Selection of phototransduction genes in Homo sapiens. *Invest Ophthalmol Vis Sci* 2013;54(8):5489-5496. PMID 23868983. doi: 10.1167/iovs.12-11454.
11. Qiao H, Garvin M, **Abràmoff MD**. Automated separation of binary overlapping trees in low-contrast color retinal images. *MICCAI - IEEE Transactions on Biomedical Engineering* 49(8):912-917; 2013.
12. Antony BJ, **Abràmoff MD**, Harper MM, Jeon W, Sohn EH, Kwon YH, Kardon R, Garvin MK. A combined machine-learning and graph-based framework for the segmentation of retinal surfaces in SD-OCT volumes. *Biomedical Optics Express*, 2013;4(12):2712-2728. [http://10.1364/BOE.4.002712]
13. van Dijk HW, Verbraak FD, Kok PH, Oberstein SY, Schlingemann RO, Russell SR, **Abràmoff MD**. Variability in photocoagulation treatment of diabetic macular oedema. *Acta Ophthalmol (Copenh)* 2013;91(8):722-727. [PMID 22973860. <http://10.1111/j.1755-3768.2012.02524.x>]

14. Kanagasingam Y, Bhuiyan A, **Abràmoff MD**, Smith RT, Goldschmidt L, Wong TY. Progress on retinal image analysis for age related macular degeneration. *Prog Retin Eye Res* 2014;38:20-42. [PMID 24211245. <http://10.1016/j.preteyeres.2013.10.002>]
15. Xu X, Reinhardt JM, Hu Q, Bakall B, Tlucek PS, Bertelsen G, **Abràmoff MD**. Retina vessel width measurement at branchings using an improved electric field theory-based graph approach. *PLoS ONE*, 7(11): e49668 ,2012 [PONE-D-12-13769].
16. Springelkamp H, Lee KM, Ramdas WD, Vingerling JR, Hofman A, Klaver CCW, Sonka M, **Abràmoff MD**, Jansonius NM. Optimizing the information yield of 3D OCT in glaucoma. *Invest Ophthalmol Vis Sci*, 53(13):8162-71, 2012.
17. Christopher M, Scheetz TE, Mullins RF, **Abràmoff MD**. Selection of phototransduction genes in Homo sapiens. *Invest Ophthalmol Vis Sci* 2013;54(8):5489-5496. PMID 23868983. doi: 10.1167/iovs.12-11454.
18. Kafieh R, Rabbani H, **Abràmoff MD**, Sonka M. Curvature of retinal OCTs using graph-based geometry detection. *Phys Bed Biol*, 2013; 58(9):2925-2938.
19. Wahle A, Lee K, Harding AT, Garvin MK, Niemeijer M, Sonka M, **Abràmoff MD**. Extending the XNAT archive tool for image and analysis management in ophthalmology research. *Proceedings SPIE Medical Imaging 2013: Advanced PACS-based Imaging Informatics and Therapeutic Applications* 2013;8674. [doi 10.1117/12.2007966]
20. **Abràmoff MD**, Mullins RF, Lee K, Hoffmann JM, Sonka M, Critser DB, Stasheff SF, Stone EM. Human Photoreceptor Outer Segments Shorten During Light Adaptation. *IOVS Invest Ophthalmol Vis Sci*. 2013 Apr 30
21. Qiao H, Garvin M, **Abràmoff MD**. Automated separation of binary overlapping trees in low-contrast color retinal images. *MICCAI - IEEE Transactions on Biomedical Engineering* 49(8):912-917; 2013.
22. Trucco E, Ruggeri A, Karnowski T, Giancardo L, Chaum E, Hubschman JP, al-Diri B, Cheung CY, Wong D, **Abràmoff MD**, Lim G, Kumar D, Burlina P, Bressler NM, Jelinek HF, Meriaudeau F, Quellec G, MacGillivray T, Bhillon B. Validating retinal fundus image analysis algorithms: Issues and a proposal. *Invest Ophthalmol Vis Sci*. 2013 May 24. 54(5):3546-3559. [doi: 10.1167/iovs.12-10347]
23. Lee K, Sonka M, Kwon YH, Garvin MK, **Abràmoff MD**. Adjustment of the retinal angle in SD-OCT of glaucomatous eyes provides better inter-visit reproducibility of peripapillary RNFL thickness. *Invest Ophthalmol Vis Sci*, 2013;54(7):4808-4812. [PMID 23788372 doi: 10.1167/iovs.13-12211]
24. Sohn EH, Chen JJ, Lee K, Niemeijer M, Sonka M, **Abràmoff MD**. Reproducibility of diabetic macular edema estimates from SD-OCT is affected by the choice of image analysis algorithm. *Invest Ophthalmol Vis Sci*. 2013;54(6):4184-4188. [PMID 23696607; doi: 10.1167/iovs.12-10420].
25. Christopher M, Tang L, Fingert JH, Scheetz, TE, **Abràmoff MD**, Changes in Quantitative 3D Shape Features of the Optic Nerve Head Associated with Age, *Proceedings SPIE Medical Imaging 2013: Computer-Aided Diagnosis* 2013;8670:art no. 867000. doi 10.1117/12.2006908.
26. Miri Saleh, M, Lee, K, Niemeijer M, **Abràmoff MD**, Kwon YH, Garvin MK, Multimodal Segmentation of Optic Disc and Cup from Stereo Fundus and SD-OCT Images, . *Proceedings SPIE Medical Imaging 2013: Image Processing (Progress in Biomedical Optics and Imaging)* 2013;8669:art no.866900. doi 10.1117/12.2007010.
27. Hu Q, Garvin ML, Christopher MA, Xu X, Scheetz TE, **Abràmoff MD**, Optimal Filter Approach for the Detection of Vessel Bifurcations in Color Fundus Images, *Proceedings SPIE Medical Imaging 2013: Image Processing (Progress in Biomedical Optics and Imaging)* 2013;8669:art no.866920. doi 10.1117/12.2007088.
28. Zhang L, Lee KM, Niemeijer M, Mullins RF, Sonka M, **Abràmoff MD**. Automated segmentation of the choroid from clinical SD-OCT. *Invest Ophthalmol Vis Sci*, 53; 12; 7510-7519, 2012
29. Tang L, Niemeijer M, Reinhardt J, Garvin MK, Sonka M, **Abràmoff MD**. Splat feature classification with application to retinal hemorrhage detection in fundus images. *IEEE Trans Med Imaging*, 2012; 32(2):364-375, 2013.
30. Chen X, Zhang L, Sohn EH, Lee KM, Niemeijer M, Chen J, Sonka M, **Abràmoff MD**. Quantification of external limiting membrane disruption caused by diabetic macular edema from SD-OCT. *Invest Ophthalmol Vis Sci*, 53;13:8042-8048, 2012.
31. Xu X, Reinhardt JM, Hu Q, Bakall B, Tlucek PS, Bertelsen G, **Abràmoff MD**. Retina vessel width measurement at branchings using an improved electric field theory-based graph approach. *PLoS ONE*, 7(11): e49668 ,2012
32. **Abràmoff MD**, Folk JC, Han DP, Walker JD, Williams DF, Russell SR, Massin P, Cochener B, Gain P, Tang L, Lamard M, Moga DC, Quellec G, Niemeijer M. Automated analysis of retinal images for detection of referable diabetic retinopathy. *JAMA Ophthalmol*, 2013; 131(3):351-357.
33. Springelkamp H, Lee KM, Ramdas WD, Vingerling JR, Hofman A, Klaver CCW, Sonka M, **Abràmoff MD**, Jansonius NM. Optimizing the information yield of 3D OCT in glaucoma. *Invest Ophthalmol Vis Sci*, 53(13):8162-71, 2012.
34. Hu Z, Niemeijer M, **Abràmoff MD**, Garvin MK. Multimodal retinal vessel segmentation from spectral-domain optical coherence tomography and fundus photography. *IEEE Trans Med Imaging*, 2012; 31(10):1900-1911.
35. Tang L, Kardon RH, Wang J-K, Garvin MK, Lee K, **Abràmoff MD**. Quantitative evaluation of papilledema from stereoscopic color fundus photographs. *Invest Ophthalmol Vis Sci*, 2012; 53(8):4490-4497.

36. Niemeijer M, Lee K, Garvin MK, **Abràmoff MD**, Sonka M. Registration of 3D spectral OCT volumes combining ICP with a graph-based approach. In *Proceedings of SPIE Medical Imaging 2012: Image Processing*, volume 8314, page 831445. SPIE, 2012.
37. Lee K, Kwon Y, Garvin M, Niemeijer M, Sonka M, **Abràmoff MD**. 3-D distribution of damage to the entire retinal ganglion-cell pathway: quantified using SD-OCT analysis in patients with glaucoma. *Arch Ophthalmol*, 2012; 130(9):1118-1126.
38. Garvin MK, **Abràmoff MD**, Lee K, Niemeijer M, Sonka M, Kwon YH. 2-D pattern of nerve fiber bundles in glaucoma emerging from spectral-domain optical coherence tomography. *Invest. Ophthalmol. Vis. Sci.* 31;53(1):483-489, 2012.
39. Kay CN, **Abràmoff MD**, Mullins RF, Kinnick TR, Lee K, Eystone ME, Chung MM, Sohn EH, Stone EM. Three-dimensional distribution of the vitelliform lesion, photoreceptors, and retinal pigment epithelium in the macula of patients with Best vitelliform macular dystrophy. *Arch Ophthalmol*, 130(3):357-364, 2012.
40. Van Dijk HW, Verbraak FD, Kok PH, Stehouwer M, Garvin MK, Sonka M, DeVries JH, Schlingemann RO, **Abràmoff MD**. Early neurodegeneration in the retina of Type 2 diabetic patients. *Invest Ophthalmol Vis Sci*, 2012; 53(6):2715-2719.
41. Sánchez CI, Niemeijer M, Išgum I, Dumitrescu A, Suttorp-Schulten MS, **Abràmoff MD**, van Ginneken B. Contextual computer-aided detection: Improving bright lesion detection in retinal images and coronary calcification identification in CT scans. *Med Image Anal.* 16(1):50-62, 2012.
42. Quellec G, Russell SR, Seddon JM, Reynolds R, Scheetz T, Mahajan VB, Stone EM, **Abràmoff MD**. Automated discovery and quantification of image based complex phenotypes: A twin study of drusen phenotypes in age-related macular degeneration. *Invest. Ophthalmol. Vis. Sci.* 25;52(12):9195-9206, 2011.
43. Antony B, **Abràmoff MD**, Tang L, Ramdas WD, Vingerling JR, Jansonius NM, Lee K, Kwon YH, Sonka M, Garvin MK. Automated 3-D method for the correction of axial artifacts in spectral-domain optical coherence tomography images. *Biomed Opt Express* 2(8):2403-2416, 2011.
44. Lee K, **Abràmoff MD**, Sonka M, Garvin MK. Automated segmentation of intraretinal layers from spectral-domain macular OCT: reproducibility of layer thickness measurements. In *Proceedings of SPIE Medical Imaging 2011: Biomedical Applications in Molecular, Structural and Functional Imaging*, volume 7965, pages 796523–8, 2011.
45. Tang L, Garvin MK, Lee K, Alward LM, Kwon YH, **Abràmoff MD**. Robust multi-scale stereo matching from fundus images with radiometric differences. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 33(11):2245-2258, 2011.
46. van Dijk HW, Verbraak FD, Stehouwer M, Kok PHB, Garvin MK, Sonka M, DeVries JH, Schlingemann RO, **Abràmoff MD**. Association of visual function and ganglion cell layer thickness in patients with diabetes mellitus type 1 and no or minimal diabetic retinopathy. *Vision Research*, 51(2):224–228, 2011.
47. Quellec G, Russell SR, **Abràmoff MD**. Optimal filter framework for automated, instantaneous detection of lesions in retinal images. *IEEE TMI*. 30(2):523-533, 2011.
48. Xu X, Niemeijer M, Song Q, Sonka M, Garvin MK, Reinhardt JM, **Abràmoff MD**. Vessel boundary delineation on fundus images using graph-based approach. *IEEE TMI*, 30(6):1184-1191, 2011.
49. Quellec G, Russell SR, Scheetz T, Stone EM, **Abràmoff MD**. Computational quantification of complex fundus phenotypes in age-related macular degeneration and Stargardt's disease. *Invest Ophthalmol Vis Sci.* 52(6):2976-2981, 2011
50. **Abràmoff MD**, Garvin M, Sonka M. Retinal imaging and image analysis. *IEEE Reviews in Biomedical Engineering*, 3:169-208, 2010
51. **Abràmoff MD**, Reinhardt JM, Russell SR, Folk JC, Mahajan VB, Niemeijer M, Quellec G. Automated early detection of diabetic retinopathy. *Ophthalmology* 117(6):1147-1154, 2010.
52. AntonyBJ, **Abràmoff MD**, Lee K, Sonkova P, Gupta P, Kwon Y, Niemeijer M, Hu Z, Garvin MK. Automated 3D segmentation of intraretinal layers from optic nerve head optical coherence tomography images. In *Proceedings of SPIE Medical Imaging 2010: Biomedical Applications in Molecular, Structural, and Functional Imaging*, volume 7626, pages 76260U–12. SPIE, 2010.
53. Hu Z, **Abràmoff MD**, Kwon YH, Lee K, Garvin M. Automated segmentation of neural canal opening and optic cup in 3-D spectral optical coherence tomography volumes of the optic nerve head. *Invest Ophthalmol Vis Sci.* 51(11):5708-5717, 2010
54. Hu Z, Niemeijer M, **Abràmoff MD**, Lee K, Garvin MK. Automated segmentation of 3-D spectral OCT retinal blood vessels by neural canal opening false positive suppression. In *Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2010, Part III, LNCS 6363*, pages 33–40. Springer-Verlag, January 2010.
55. Lee K, **Abràmoff MD**, Niemeijer M, Garvin MK, Sonka M. 3-D segmentation of retinal blood vessels in spectral-domain OCT volumes of the optic nerve head. In *Proceedings of SPIE Medical Imaging 2010: Biomedical Applications in Molecular, Structural, and Functional Imaging*, volume 7626, pages 76260V–8. SPIE, 2010.
56. Lee S, Reinhardt JR, Cattin M, **Abràmoff MD**. Objective and expert-independent validation of retinal image registration algorithms by a projective imaging distortion mode. *Med Image Anal* 14(4):539-549, 2010.

57. Lee K, Niemeijer M, Garvin MK, Kwon YH, Sonka M, **Abràmoff MD**. Segmentation of the optic disc in 3-D OCT scans of the optic nerve head. *IEEE Transactions on Medical Imaging*, 29(1):159–168, January 2010.
58. Tang L, Scheetz TE, Mackey DA, Hewitt AW, Fingert JH, Kwon YH, Queller G, Reinhardt JM, **Abràmoff MD**. Automated quantification of inherited phenotypes from color images: A twin study of the variability of the optic nerve head shape. *Invest Ophthalmol Vis Sci* 51(11):5870-5877, 2010.
59. Queller G, Lee K, Dolejsi M, Garvin MK, **Abràmoff MD**, Sonka M. Three-dimensional analysis of retinal layer texture: Identification of fluid-filled regions in SD-OCT of the macula. *IEEE Trans Med Imaging* 29(6):1321-1330, 2010
60. VanDijk HW, Verbraak FD, Kok PH, Garvin MK, Sonka M, Lee K, Devries JH, vanVelthoven ME, Schlingemann RO, **Abràmoff MD**. Decreased retinal ganglion cell layer thickness in Type 1 diabetic patients. *Invest Ophthalmol Vis Sci*. 51(7):3660-3665, 2010.
61. Lee K, Niemeijer M, Garvin MK, Kwon YH, Sonka M, **Abràmoff MD**. Segmentation of the optic disc in 3D-OCT scans of the optic nerve head. *IEEE Trans Med. Imaging*, 29(1):159-168, 2010.
62. **Abràmoff MD**, Lee K, Niemeijer M, Alward LM, Greenlee EC, Garvin MK, Sonka M, Kwon YH. Automated segmentation of the cup and rim from spectral domain OCT of the optic nerve head. *Invest Ophthalmol Vis Sci* 50(12):5778-5784, 2009.
63. Garvin MK, **Abràmoff MD**, Wu X, Burns TK, Russell SR, Sonka M. Automated 3-D intraretinal layer segmentation of macular spectral-domain optical coherence tomography images. *IEEE Trans Med. Imaging*, 28(9):1436-47, 2009.
64. Hu Z, Niemeijer M, Lee K, **Abràmoff MD**, Sonka M, Garvin MK. Automated segmentation of the optic disc margin in 3-D optical coherence tomography images using a graph- theoretic approach. In *Proceedings of Medical Imaging 2009: Biomedical Applications in Molecular, Structural, and Functional Imaging*, volume 7262, pages 72620U–11. SPIE, 2009.
65. Lee K, Niemeijer M, Garvin MK, Sonka M, Kwon YH, **Abràmoff MD**. 3-D segmentation of the rim and cup in spectral-domain optical coherence tomography volumes of the optic nerve head. *Proceedings of SPIE Medical Imaging 2009: Biomedical Applications in Molecular, Structural, and Functional Imaging*, volume 7262, pages 72622D–9. SPIE, 2009.
66. Garvin MK, **Abràmoff MD**, Kardon R, Russell SR, Wu X, Sonka M. Intraretinal layer segmentation of macular Optical Coherence Tomography images using Optimal 3-D graph search. *IEEE Trans Med. Imaging*, 27(10), 1495-1505, 2008.
67. Niemeijer M, Garvin M, van Ginneken B, Sonka M, **Abràmoff MD**. Vessel segmentation in 3D spectral OCT scans of the retina. *Proc SPIE Med Imag*, 2008
68. Staal J, **Abràmoff MD**, Niemeijer M, Viergever M, van Ginneken B. Ridge based vessel segmentation in color images of the retina. *IEEE Transactions on Medical Imaging*. 23(4):501-509, 2004.
69. **Abràmoff MD**, Kwon YH, Tso DY, Li H, Barriga ES, Kardon R. A spatial truncation approach to the analysis of optical imaging of the retina in humans and cats. *Proc IEEE International Symposium on Biomedical Imaging 2004*; 2:1115-1118, 2004.
70. **Abràmoff MD**, Viergever MA. Computation and visualization of three dimensional soft tissue motion in the orbit. *IEEE Transactions on Medical Imaging*; 21(4):296-304, 2002.
71. **Abràmoff MD**, Niessen WJ, Viergever MA. Objective quantification of the motion of soft tissues in the orbit. *IEEE Trans on Medical Imaging*; 19(10):986-995, 2000.

C. Research Support

Arnold and Mabel Beckman Initiative for Macular Research Abràmof PI 7/1/2013-7/1/2014
 Association of Visual Function with objectively quantified distribution of deposits in patients with Atrophic Age-Related Macular Degeneration

72. R01 EY019112 Abràmoff PI – with Sonka MPI 5/1/2010 – 4/30/2015 NIH/NEI
 Retinal Therapy Guided by 3-D OCT Image Analysis

The main goal is to develop OCT-image analysis of age-related macular degeneration (AMD) treatment and study its performance in 200 subjects with AMD.

73. R01 EY018853 Abràmoff PI – with Sonka, Kwon MPIs 8/1/2009 – 6/30/2016 NIH/NEI
 Focal Structure-Function Relationships in Macular Layers from 3D Spectral OCT

The main goal is to study structure-function relationships between ONH images and visual function in glaucoma.

I01 CX000119 Abràmoff PI 7/1/2013 – 6/20/2016 VA Rehabilitation

Retinal vessel measurements as clinically useful predictors in veterans

We have recently developed an automated, precise, fast, novel tool for measuring retinal vessels in these retinal images. Manual measurement of retinal vessels by hand has shown that these can predict future – not current - development of hypertension and also diabetic retinopathy . If we can confirm that our tool can flag those veterans at increased risk for developing these diabetes complications, this will allow earlier intervention and prevention. Because the tool only uses the images that are being taken anyway, there is no extra effort for either the veteran or VA staff.

Veterans Administration Merit Abràmoff PI 1/1/2011 – 8/30/2014 VA Merit

Computer aided versus automated detection of diabetic retinopathy

Main goal is to compare prospectively retinal expert alone, retinal expert assisted by computer diagnosis, and standalone computer diagnosis of diabetic retinopathy in veterans with diabetes

COMPLETED SUPPORT

- 10/2005–6/2010 NIH/NEI R01 EY017066 PI. Low cost, patient friendly, portable imaging and computer detection of diabetic retinopathy Main goal is to develop automated algorithms for detection of diabetic retinopathy through image analysis, and integrate this with low cost scanning laser technology
- 2007-2009 PI. Carl Zeiss Meditec Inc. "Optic nerve head cup and disc classification from 3D OCT".
- 2007- Investigator (PI: Soliz, Pete). National Eye Institute (NIH). 1R44EY018280, phase I "Computer-based Screening for Diabetic Retinopathy. \$100k. In this grant, a set of algorithms has been developed to automatically detect abnormalities associated with diabetic retinopathy in digital retinal images.
- 2005-2007 PI. Wellmark Foundation
"Tele-diagnosis of Diabetic Retinopathy in Rural Iowa" Phase 1 and 2.
- 2006-2008 PI. University of Iowa Centers of Excellence
"Towards a prototype of a patient-friendly low-cost retinal camera".
- 2006-2007 PI. STTR Department of Defense
"Inline treatment of subretinal lesions".
- 2005-2006 PI. GCRC University of Iowa
"Automated classification of optic nerve head from stereo photographs"
Develop and test algorithms that can perform automated classification of the optic nerve head of patients with glaucoma.
- 2006-2007 PI. US Department of Agriculture, Distance Learning Telemedicine Program
"Telediagnosis of diabetic retinopathy in the rural Midwest"
Determine patient expectations and experience of retinal telediagnosis using digital cameras.
- 2004-2006 K-12 recipient. PI: Mark. RR01770001 K12 Career Development Award, University of Iowa /NIH
"Determine the potential of functional imaging of the retina using near-infrared tissue reflectance in response to visual stimuli".
- 2002-2006 PI. IOP STW (Netherlands Government)
"Computer aided diagnosis for diabetic retinopathy in fundus images".