MAHMUT KARAKAYA

Kennesaw State University
Dept. of Computer Science
Marietta, GA 30060

Permanent Resident of the USA
mkarakay@kennesaw.edu
(470) 578 6983

BACKGROUND

Machine Learning, Pattern Recognition
Security, Biometrics, Iris Recognition
Medical Imaging and Digital Image Processing
Smart Camera Networks, Sensor Networks, Hyperspectral Imaging.

PROFESSIONAL EXPERIENCE

2020 – Present   Assistant Professor
Department of Computer Science, Kennesaw State University, Marietta, GA

2016 – 2020   Assistant Professor
Department of Computer Science, University of Central Arkansas, Conway, AR

2013 – 2016   Assistant Professor
Department of Electrical & Electronics Engineering, Meliksah University, Kayseri, TURKEY

2011 – 2013   Postdoctoral Research Associate
Imaging Science and Machine Learning Group, Oak Ridge National Laboratory, TN

2005 – 2011   Graduate Research & Teaching Assistant
AICIP Lab, The University of Tennessee, Knoxville, TN
VIPS   Lab, University of South Alabama, Mobile, AL

RESEARCH PROJECTS

Biometrics to Improve Standoff Iris Recognition Systems
- Developing machine learning algorithms to improve the performance of standoff iris recognition in the presence of gaze angle and pupil dilation
- Developing computer vision and deep learning algorithms for iris segmentation, gaze angle estimation, and frontal projection in iris images
- Designed data collection platform to capture standoff iris images using NIR-cameras
- Generating a large standoff iris dataset with 450,000 images from 113 subjects
- Investigating effect of corneal refraction, limbus occlusion, and iris shape on recognition.

Diabetic Retinopathy Detection Using Smartphone-Based Retinal Imaging
- Developing machine learning algorithms to detect Diabetic Retinopathy (DR)
- Designing deep learning frameworks for DR detection and optic disc localization at smartphone and fundus camera retina images
- Comparing smartphone-based systems as iExaminer, D-Eye, iNview, and Peek Retina
- Collecting retina images using smartphone-based retinal imaging devices
- Generating a synthetic smartphone-based retinal image dataset

Smartphone-Based Portable Invisible Data Matrix Imaging Systems
- Designed an affordable and portable invisible data matrix reader system for smartphones using 3D printing technology with optic lens, high-pass filter, and light source
- Developed computer vision algorithms to detect and decode invisible data matrix images
- Developed an android application for authentication of invisible data matrix

Computational Methods in Neuroscience & Live Cell Imaging
- Developing segmentation algorithms for leading and trailing processes of neurons.
- Developing 3D Stitching algorithms to reconstruct neuron images from multiple images.
- Designed an automatic detection, segmentation, and classification algorithm to discover morphological features of retinal neurons in large-scale 3D confocal images.
- Developing algorithms for comprehensive characterization of live cells to understand the functions of proteins, molecular interactions, and networks.

Eye Gaze Tracking
- Developing less constraint gaze tracking algorithms using the correlation filters
- Designed an optical system for gaze tracking using webcam and zoom lens at computers
- Designed data collection protocols and software to collect data from 30 subjects

Collaborative Solutions to Smart Camera Networks
- Designed lightweight and energy efficient target detection, localization and tracking algorithms in crowds using a progressive certainty map in smart camera networks.
- Designed fault detection, correction, and tolerance algorithm for target localization.
- Analyzed coverage estimation problem in the presence of occlusions and proposed a closed form solution for the visual coverage estimation in smart camera networks.
- Designed a new version of Mobile Sensor Platform with acoustic and imaging capabilities.

RESEARCH GRANTS

10/2019 – 09/2022   Standoff Iris Recognition Systems Using Deep Learning Frameworks
Funding Agency: NSF-SaTC
Role: Principal Investigator   **Total Budget:** $259,316

08/2021 – 07/2022 Computerized Assessment and Real-Time Assistance for 3D Cataract Surgery
Funding Agency: Office of Research at Kennesaw State University
Role: Principal Investigator   **Total Budget:** $15,000

01/2018 – 04/2020   Development of Retina Imaging System using Smartphones
Funding Agency: NIH NIGMS/ Arkansas INBRE
Role: Principal Investigator   **Total Budget:** $291,800

10/2017 – 09/2020   MRI: Acquisition of a High-Performance Computing System for UCA
Funding Agency: NSF-CNS
Role: Senior Personnel   **Total Budget:** $105,084

01/2017 – 12/2018   Understanding the Effect of Pupil Dilation on Off-angle Iris Recognition
Funding Agency: Research Council at University of Central Arkansas
Role: Principal Investigator   **Total Budget:** $7,653

04/2015 – 10/2016   Development of Invisible Data Matrix Reader System with Smartphones
Funding Agency: The Scientific and Technological Research Council of Turkey (TÜBİTAK)
Role: Principal Investigator   **Total Budget:** $67,000

11/2013 – 10/2015   Improving Iris Recognition Algorithms for Non-Ideal Iris Images
Funding Agency: The Scientific and Technological Research Council of Turkey (TÜBİTAK)
Role: Principal Investigator   **Total Budget:** $50,000

06/2014 – 07/2015   Improving Performance of Iris Recognition for Off-Angle Iris Images
Funding Agency: Meliksah University
Role: Principal Investigator   **Total Budget:** $12,000

PATENTS

1. **M. Karakaya**, Smartphone based portable retina imaging system, Turkey, 2014/00902
2. **M. Karakaya**, Invisible data matrix reader system for smartphones, Turkey, 2015/16758.

AWARDS & HONORS

- Chancellor's Honor for Extraordinary Professional Promise at University of Tennessee, 2010.
- Best Paper Award in ACM/IEEE Inter. Conf. on Distributed Smart Cameras, 2009.
- Full-scholarship and High Honor Student at Fatih University, Turkey, 2000-2005.
- Ranked 14th among 200,000 technical high school graduates in the nationwide university admissions examination, Turkey, 2000.

EDUCATION

2011 **PhD in Computer Engineering,** University of Tennessee, Knoxville, TN
Dissertation Topic: Collaborative Solutions to Visual Sensor Networks

2007 **M.S. in Electrical Engineering,** University of South Alabama, Mobile, AL
Thesis: Enhanced SEM Algorithm for Object Detection in Hyperspectral Imagery

2005 **B.S. in Electronics Engineering,** Fatih University, Istanbul, TURKEY

TEACHING EXPERIENCE

Assistant Professor

KSU : Dept. of Computer Science, Kennesaw State University, Marietta, GA
UCA: Dept. of Computer Science, University of Central Arkansas, Conway, AR
MU : Dept. of Electrical and Electronics Engineering at Meliksah University, TURKEY

- **CS 7267**   : Machine Learning (F'21) @KSU
- **CS 7367**   : Machine Vision (S'21, S'22) @KSU
- **CS 3503**   : Computer Architecture and Organization (F'20, S'21, S'22) @KSU
- **ENGR 3415** : Digital Logic Design & Lab (S'19, F'19, S'20) @UCA
- **ENGR 3340** : Digital Image Processing (F'16, S'18, F'18, F'19) @UCA
- **CSCI 2440**   : Assembly Language and Computer Organization (F'16, S'17, F'17) @UCA
- **EEE 301/302** : Electronics I&II (S'14, F'14, S'15, F'15, S'16) @ MU
- **EEE 422/566** : Digital Image Processing (S'14, F'14, F'15, S'16) @ MU

BOOK CHAPTERS

1. D. S. Bolme, H. Santos-Villalobos, J. Thompson, **M. Karakaya** and C. Bensing Boehnen, "Off-Angle Iris Correction Methods" Handbook of Iris Recognition, ISBN 978-1-4471-6784-6, 2016.

JOURNAL PUBLICATIONS

1. **M. Karakaya**, "Iris-Ocular-Periocular: Towards more accurate Biometrics for Off-angle Images" Journal of Electronic Imaging, 30(3), 033035, 2021.

2. E. Jalilian, **M. Karakaya** and A. Uhl, "CNN Based Off-angle Iris Segmentation and Recognition" IET Biometrics, 10(5), pp. 518-535 2021.

3. **M. Karakaya** and R. E. Hacisoftaoglu "Comparison of Smartphone-based Retinal Imaging Systems for Diabetic Retinopathy Detection using Deep Learning" BMC Bioinformatics, 21(Suppl 4):259, 2020.

4. R. E. Hacisoftaoglu, **M. Karakaya** and A. B. Sallam, "Deep Learning Framework for Diabetic Retinopathy Detection with Smartphone-based Retinal Imaging Systems" Pattern Recognition Letters, vol. 135, pp. 409-417, 2020.

5. **M. Karakaya** and E. T. Celik "Effect of Pupil Dilation on Off-angle Iris Recognition" Journal of Electronic Imaging, 28(3), 033022, June 2019.

6. **M. Karakaya**, "A study of how gaze angle affects the performance of iris recognition" Pattern Recognition Letters, vol. 82, Part 2, pp. 132-143, Oct. 2016.

7. **M. Karakaya** and H. Qi, "Collaborative Localization in Visual Sensor Networks", ACM Transactions on Sensor Networks, vol. 10, issue 2, article 18, pp. 1-24, Jan. 2014.

8. N. Trivedi, J. S Ramahi, **M. Karakaya**, D. Howell, R. A Kerekes and D. J Solecki, "Leading-process actomyosin coordinates organelle positioning and adhesion receptor dynamics in radially migrating cerebellar granule neurons", Neural Development, 9:26, 2014.

9. **M. Karakaya** and H. Qi, "Coverage Estimation for Crowded Targets in Visual Sensor Networks", ACM Transactions on Sensor Networks, vol. 8, issue 3, article 26, pp. 1-22, 2012.

10. **M. Karakaya** and H. Qi, "Distributed Target Localization using a Progressive Certainty Map in Visual Sensor Networks", Journal of Ad Hoc Networks, vol. 9, pp. 576–590, 2011.

11. R. A. Kerekes, R. A. Martins, D. Davis, **M. Karakaya**, S. S. Gleason and M. A. Dyer, "Automated Tracing of Horizontal Neuron Processes During Retinal Development", Neurochemical Research, vol. 36, no. 4, pp. 583-593, 2011.

12. R. A. P. Martins, D. Davis, R. A. Kerekes, J. Zhang, I. T. Bayazitov, D. Hiler, **M. Karakaya**, S. Frase, S. S. Gleason, S. S. Zakharenko, D. A. Johnson, and M. A. Dyer, "Retinoblastoma (Rb) regulates laminar dendritic arbor reorganization in retinal horizontal neurons", Proceedings of the National Academy of Science 108: 21111-21116, 2011.

CONFERENCE PROCEEDINGS

1. **M. Karakaya**, R.S. Aygun, and A. Sallam, "Collaborative Deep Learning for Privacy Preserving Diabetic Retinopathy Detection", submitted to IEEE EMBC 2022.

2. K. Diab and **M. Karakaya**, "CNN-based Gaze Estimation for Off-angle Iris Images", submitted to IEEE Southeast Conference 2022.

3. S. Phillips and **M. Karakaya**, "Effects of Distance and Gaze Angle on CNN-Based Standoff Iris Recognition", submitted to IEEE Southeast Conference 2022.

4. E. Jalilian, G. Wimmer, **M. Karakaya** and A. Uhl, "Deep Learning based Off-angle Iris Recognition", accepted by IEEE International Conference on Acoustics, Speech, & Signal Processing (ICASSP), 2022.

5. **M. Karakaya**, "Fragile Bits in Off-angle Iris Recognition", IEEE International Workshop on Biometrics and Forensics (IWBF), pp. 1-6, 2021.

6. E. Elrich and **M. Karakaya**, "Comparison of Elliptical Unwrapping and Frontal Projection for Off-angle Iris Normalization", SPIE Defense and Commercial Sensing Conference 2021.

7. E. Jalilian, **M. Karakaya** and A. Uhl, "End-to-end Off-angle Iris Recognition Using CNN Based Iris Segmentation", International Conference of the Biometrics Special Interest Group (BIOSIG), 2020.

8. D. Kim, R. E. Hacisoftaoglu, and **M. Karakaya**, "Optic Disc Localization in Retina Images using Deep Learning Framework", Proc. SPIE 11419, Disruptive Technologies in Information Sciences IV, 2020.

9. E. Jalilian, A. Uhl, and **M. Karakaya**, "Gaze-angle Impact on Iris Segmentation using CNNs", IEEE International Conference on Biometrics: Theory, Applications and Systems, Sep 2019.

10. R. E. Hacisoftaoglu and **M. Karakaya**, "Field of View of Portable Ophthalmoscopes for Smartphones" SPIE Defense and Computational Sensing Conference, April 2019.

11. **M. Karakaya**, "Deep Learning Frameworks for Off-Angle Iris Recognition" IEEE International Conference on Biometrics: Theory, Applications and Systems, Oct 2018.

12. S. Cetin and **M. Karakaya,** "Effect of segmentation errors on off-angle iris recognition" Disruptive Technologies in Information Sciences, SPIE, Orlando, FL, 2018.

13. E. T. Celik and **M. Karakaya**, "Pupil Dilation at Synthetic Off-angle Iris Images" Inter. Conference of the Biometrics Special Interest Group (BIOSIG), Germany, Sep. 2016.

14. H. Sun, M. C. Uysalturk and **M. Karakaya**, "Invisible 2D Data Matrix Detection with Smart Phone Using Geometric Correction and Hough Transform" Optical Pattern Recognition XXVII, 98450P, SPIE, Baltimore, MD, Apr 2016.

15. O. M. Kurtuncu, G. N. Cerme and **M. Karakaya**, "Comparison and evaluation of datasets for off-angle iris recognition" Sensors, and Command, Control, Communications, and Intelligence Technologies for Homeland Security, Defense, and Law Enforcement Applications XV, 98250O, SPIE, Baltimore, MD, Apr 2016.

16. O. M. Kürtüncü and **M. Karakaya**, "Limbus Impact Removal for Off-angle Iris Recognition using Eye Models" IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS), Washington DC, Sep 2015.

17. G. N. Cerme and **M. Karakaya**, "3D iris structure impact on iris recognition", IEEE Conference on Signal Processing and Communications Applications, TURKEY, 2015.

18. **M. Karakaya,** R. Yoldash and C. B. Boehnen "A Gallery Approach for Off-angle Iris Recognition", Biometric and Surveillance Technology for Human and Activity Identification XII, 945708, SPIE, Baltimore, MD, Apr 2015.

19. **M. Karakaya,** D. Bolme, and C. Boehnen. "Eye Gaze Tracking Using Correlation Filters", Image Processing: Machine Vision Applications VII, SPIE, vol. 9024, no. 29, Feb 2014.

20. T. Yang, J. Stahl, S. Schuckers, F. Hua, C. B. Boehnen, **M. Karakaya**, "Gaze angle estimate and correction in iris recognition", IEEE Symposium on Computational Intelligence in Biometrics and Identity Management, pp.132-138, Dec. 2014

21. J. Thompson, H. S. Villalobos, **M. Karakaya,** D. Barstow, D. Bolme, and C. Boehnen, "Off-angle Iris Correction using a Biological Model", IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS), Washington DC, Aug 2013.

22. **M. Karakaya,** D. Barstow, H. S. Villalobos, J. Thompson, D. Bolme, and C. Boehnen, "Limbus Impact on Off-angle Iris Degradation", International Conference on Biometrics, June 2013.

23. **M. Karakaya**, R. A. Kerekes, and D. J. Solecki, "Automated Tracing and Segmentation Tool for Migrating Neurons in 4D Confocal Imagery", Biomedical Sciences and Engineering Conference (BSEC), May 2013.

24. **M. Karakaya,** D. Barstow, H. S. Villalobos, J. Thompson, D. Bolme, and C. Boehnen, "Gaze Estimation for ORNL Biometric Eye Model in Off-angle Iris Recognition", Biometrics and Surveillance Technology for Human and Activity Identification X, vol. 8712:14, May 2013.

25. **M. Karakaya**, D. Barstow, H. S. Villalobos, and C. Boehnen, "An Iris Segmentation Algorithm based on Edge Orientation for Off-angle Iris Recognition", Image Processing: Machine Vision Applications VI, SPIE, vol. 86617, no. 5, Feb 2013.

26. **M. Karakaya** and H. Qi, "Communication and Energy Efficiency in Visual Sensor Networks for People Localization", Future of Instrumentation Inter. Workshop, Oct 2012.

27. H. S. Villalobos, D. Barstow, **M. Karakaya**, E. Chaum, and C. Boehnen, "ORNL Biometric Eye Model for Iris Recognition", IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS 2012), Washington DC, Aug 2012.

28. **M. Karakaya**, R. A. Kerekes, J. L. Morrell-Falvey, C. Foster, and S. T. Retterer, "Analysis of Tight Junction Formation and Integrity", IEEE International Conference of the Engineering in Medicine and Biology, San Diego CA, Aug 2012.

29. **M. Karakaya** and H. Qi, "Coverage Estimation in Heterogeneous Visual Sensor Networks", 8th IEEE Inter. Conf. on Distributed Computing in Sensor Systems, Hangzhou, China, 2012.

30. **M. Karakaya** and H. Qi, "Detection-based Tracking for Crowded Targets in Distributed Visual Sensor Networks", Future of Instrumentation International Workshop, 2011.

31. **M. Karakaya**, R. A. Kerekes, S. S. Gleason, R. A. Martins, and M. Dyer, "Automatic Detection, Segmentation and Classification of Retinal Horizontal Neurons in Large-scale 3D Confocal Imagery", SPIE Medical Imaging Conference, Vol. 7962, Orlando FL, 2011.

32. **M. Karakaya** and H. Qi, "Fault Detection, Correction, and Tolerance for Collaborative Target Localization in Visual Sensor Networks", ACM/IEEE International Conference on Distributed Smart Cameras, Atlanta GA, 2010.

33. **M. Karakaya** and H. Qi, "Target Detection and Counting in Crowds with a Progressive Certainty Map in Distributed Visual Sensor Networks", ACM/IEEE International Conference on Distributed Smart Cameras, Como, Italy, 2009. (**Best Paper Award**)

34. **M. Karakaya**, M. S. Alam and M. I. Elbakary, "Target Detection in High Dimensional Space Using a Stochastic Expectation Maximization Algorithm", Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XIII, SPIE, vol. 6565, May 2007.

THESIS SUPERVISION

- R. E. Hacisoftaoglu, "Deep Learning Frameworks for Diabetic Retinopathy Detection using Smartphone-based Retinal Imaging Systems" Thesis, Uni. of Central Arkansas, Dec 2019.
- R. Yoldash, "Gallery Approach for Off-angle Iris Recognition Systems" M.S. Thesis, Meliksah University, Turkey, May 2016.
- M. Uysalturk, "Detection and Decoding of The Invisible Data Matrix With Smart Phone by Using Hough Lines and Online Learning" M.S. Thesis, Meliksah University, Aug 2015.
- H. Sun, "Invisible 2D Data Matrix Detection with Smart Phone Using Geometric Correction by Hough Transform" M.S. Thesis, Meliksah University, Turkey, March 2015.

PROFESSIONAL SERVICES & MEMBERSHIP & AFFILIATIONS

- Member of the IEEE (since 2007) and SPIE (since 2015).
- Reviewer for Journal of Electronic Imaging, Pattern Recognition Letters, Pattern Recognition, IEEE Sensors, IEEE International Conference on Intelligent Robots and Systems, Concurrency and Computation: Practice and Experience, Ad Hoc & Sensor Wireless Networks, Journal of Ambient Intelligence & Humanized Computing, Ad Hoc Networks, Computers in Biology and Medicine.

References available upon request