

# Nathan Jacobs

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## Areas of Expertise

Computer Vision, Deep Learning, Remote Sensing, Medical Imaging, Multimodal Integration

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## 1 Education

2005–2010	Ph.D. in Computer Science Adviser: Robert Pless, Ph.D. Thesis: Calibrating and Using the Global Network of Outdoor Webcams	Washington University in St. Louis
1995–1999	B.S. in Computer Science (Minor in Mathematics) <i>Summa Cum Laude</i> with Honors	University of Missouri

## 2 Appointments and Affiliations

### Active

<b>Professor (with Tenure)</b> 2022–	Dept. of Computer Science & Engineering, Washington University <i>St. Louis, MO</i>
<b>Affiliated Faculty</b> 2022–	Division of Computational & Data Sciences, Washington University <i>St. Louis, MO</i>
<b>Affiliated Faculty</b> 2022–	Imaging Science Program, Washington University <i>St. Louis, MO</i>

<b>Affiliated Faculty</b> 2022–	Electrical and Systems Engineering, Washington University <i>St. Louis, MO</i>
<b>Associate Faculty</b> 2022–	Taylor Geospatial Institute <i>St. Louis, MO</i>
<b>Biodiversity Fellow</b> 2022–	Living Earth Collaborative <i>St. Louis, MO</i>
<b>Technical Consultant / Owner / Founder</b> 2019–present	Multidomain Vision Research, LLC <i>St. Louis, MO</i>

## Prior

<b>Professor (with Tenure)</b> 2021–2022	Dept. of Computer Science, University of Kentucky <i>Lexington, KY</i>
<b>Director of Graduate Studies (Data Science)</b> 2020–2022	Dept. of Computer Science, University of Kentucky <i>Lexington, KY</i>
<b>Member</b> 2017–2022	Institute for Biomedical Informatics, University of Kentucky <i>Lexington, KY</i>
<b>Associate Professor (with Tenure)</b> 2016–2021	Dept. of Computer Science, University of Kentucky <i>Lexington, KY</i>
<b>Co-Department Chair (interim)</b> 2019–2020	Dept. of Computer Science, University of Kentucky <i>Lexington, KY</i>
<b>Affiliated Faculty</b> 2010–2019	Center for Visualization and Virtual Environments, University of Kentucky <i>Lexington, KY</i>
<b>Visiting Research Scientist (sabbatical)</b> 2017–2018	Orbital Insight, Inc. <i>Mountain View, CA</i>
<b>Assistant Professor</b> 2010–2016	Dept. of Computer Science, University of Kentucky <i>Lexington, KY</i>
<b>Computer Vision Research Intern</b> 2008	ObjectVideo, Inc. <i>Reston, VA</i>
<b>Graduate Research Assistant</b> 2005–2010	Dept. of Computer Science & Engineering, Washington University <i>St. Louis, MO</i>

## 3 Awards

- Highlighted Reviewer Recognition (top 8%) [ICLR 2022]
- Outstanding Reviewer Recognition [BMVC 2021]
- Outstanding Reviewer Recognition (top 10%) [NeurIPS 2020]
- Outstanding Reviewer Recognition [ICCV 2019]
- University of Kentucky, College of Engineering Dean’s Award for Excellence in Research [2018]
- Google Faculty Research Award [2018]
- Outstanding Reviewer Recognition [CVPR 2017]

- National Science Foundation CAREER Award [2016]
- Google Faculty Research Award [2016]
- Best Student Paper Award at Applied Imagery Pattern Recognition [2009]
- Ph.D. Forum Prize at the ACM/IEEE International Conference on Distributed Smart Cameras [2009]
- Best Talk Award for the Doctoral Student Seminar, Department of Computer Science, the Washington University in St. Louis, [Fall 2006]

## 4 Publications

### Journal Articles

- [1] X. Xing, M. U. Rafique, G. Liang, H. Blanton, Y. Zhang, C. Wang, N. Jacobs, and A.-L. Lin, “Efficient training on alzheimer’s disease diagnosis with learnable weighted pooling for 3d pet brain image classification,” *Electronics*, vol. 12, no. 2, 2023, Impact factor: 2.69. DOI: [10.3390/electronics12020467](https://doi.org/10.3390/electronics12020467).
- [2] X. X. Zhu, Y. Wang, M. Kochupillai, M. Werner, M. Haberle, E. J. Hoffmann, H. Taubenbock, D. Tuia, A. Levering, N. Jacobs, A. Kruspe, and K. Abdulahhad, “Geo-information harvesting from social media data,” *IEEE Geoscience and Remote Sensing Magazine*, Dec. 2022, (in press), Impact factor: 8.225.
- [3] G. Liang, H. Ganesh, D. Steffe, L. Liu, N. Jacobs, and J. Zhang, “Development of cnn models for the enteral feeding tube positioning assessment on a small scale data set,” *BMC Medical Imaging*, vol. 22, Mar. 2022, ISSN: 1471-2342. DOI: [10.1186/s12880-022-00766-w](https://doi.org/10.1186/s12880-022-00766-w).
- [4] R. Padilha, T. Salem, S. Workman, F. A. Andaló, A. Rocha, and N. Jacobs, “Content-based detection of temporal metadata manipulation,” *IEEE Transactions on Information Forensics and Security*, pp. 1316–1327, Mar. 2022. DOI: [10.1109/TIFS.2022.3159154](https://doi.org/10.1109/TIFS.2022.3159154).
- [5] S.-C. Lin, Y. Su, G. Liang, Y. Zhang, N. Jacobs, and Y. Zhang, “Estimating cluster masses from SDSS multi-band images with transfer learning,” *Monthly Notices of the Royal Astronomical Society (MNRAS)*, vol. 512, pp. 3885–3894, 3 Mar. 2022, Impact factor: 5.287. DOI: [10.1093/mnras/stac725](https://doi.org/10.1093/mnras/stac725).
- [6] M. U. Rafique, J. Zhu, and N. Jacobs, “Automatic segmentation of sinkholes using a convolutional neural network,” *Earth and Space Science*, p. 19, Dec. 2021, Impact factor: 3.138. DOI: [10.1002/essoar.10509794.1](https://doi.org/10.1002/essoar.10509794.1).
- [7] G. Liang, C. Greenwell, Y. Zhang, X. Xing, X. Wang, R. Kavuluru, and N. Jacobs, “Contrastive cross-modal pre-training: A general strategy for small sample medical imaging,” *IEEE Journal of Biomedical and Health Informatics*, vol. 26, 4 Sep. 2021, Impact factor: 5.223, ISSN: 2168-2184. DOI: [10.1109/JBHI.2021.3110805](https://doi.org/10.1109/JBHI.2021.3110805).
- [8] D. Tuia, R. Roscher, J. D. Wegner, N. Jacobs, X. X. Zhu, and G. Camps-Valls, “Towards a collective agenda on ai for earth science data analysis,” *IEEE Geoscience and Remote Sensing Magazine*, vol. 9, no. 2, pp. 88–104, Jun. 2021, Impact factor: 8.225. DOI: [10.1109/MGRS.2020.3043504](https://doi.org/10.1109/MGRS.2020.3043504).
- [9] J. Zhu, A. Nolte, N. Jacobs, and M. Ye, “Machine learning in identifying karst sinkholes from LiDAR-derived topographic depressions in the Bluegrass region of Kentucky,” *Journal of Hydrology*, Sep. 2020, Impact factor: 4.405. DOI: [10.1016/j.jhydrol.2020.125049](https://doi.org/10.1016/j.jhydrol.2020.125049).
- [10] Y. Su, Y. Zhang, G. Liang, J. ZuHone, D. Barnes, N. Jacobs, M. Ntampaka, W. Forman, P. Nulsen, R. Kraft, and C. Jones, “A deep learning view of the census of galaxy clusters in IllustrisTNG,” *Monthly Notices of the Royal Astronomical Society (MNRAS)*, Sep. 2020, Impact factor: 5.356. DOI: [10.1093/mnras/staa2690](https://doi.org/10.1093/mnras/staa2690).
- [11] T. C. Hammond, X. Xing, C. Wang, D. Ma, K. Nho, P. K. Crane, F. Elahi, D. A. Ziegler, G. Liang, Q. Cheng, L. M. Yanckello, N. Jacobs, and A.-L. Lin, “Beta-amyloid and tau drive early Alzheimer’s disease decline while glucose hypometabolism drives late decline,” *Communications Biology*, vol. 3, no. 1, p. 352, Jul. 2020, Impact factor: 6.268. DOI: [10.1038/s42003-020-1079-x](https://doi.org/10.1038/s42003-020-1079-x).

- [12] X. Wang, G. Liang, Y. Zhang, H. Blanton, Z. Bessinger, and N. Jacobs, “Inconsistent performance of deep learning models on mammogram classification,” *Journal of the American College of Radiology*, Jun. 2020, Impact factor: 3.785. DOI: [10.1016/j.jacr.2020.01.006](https://doi.org/10.1016/j.jacr.2020.01.006).
- [13] R. V. Maretto, L. M. G. Fonseca, N. B. Jacobs, T. S. Körting, H. N. Bendini, and L. L. Parente, “Spatio-temporal deep learning approach to map deforestation in Amazon rainforest,” *IEEE Geoscience and Remote Sensing Letters*, vol. 18, no. 5, pp. 771–775, Apr. 2020, Impact factor: 3.534. DOI: [10.1109/LGRS.2020.2986407](https://doi.org/10.1109/LGRS.2020.2986407).
- [14] H. Hamraz, N. B. Jacobs, M. A. Contreras, and C. H. Clark, “Deep Learning for Conifer/Deciduous Classification of Airborne LiDAR 3D Point Clouds Representing Individual Trees,” *ISPRS Journal of Photogrammetry and Remote Sensing*, vol. 158, pp. 219–230, Dec. 2019, Impact factor: 6.946, ISSN: 0924-2716. DOI: [10.1016/j.isprsjprs.2019.10.011](https://doi.org/10.1016/j.isprsjprs.2019.10.011).
- [15] R. P. Mihail, G. Liang, and N. Jacobs, “Automatic hand skeletal shape estimation from radiographs,” *IEEE Transactions on NanoBioscience*, vol. 18, no. 3, pp. 296–305, Apr. 2019, Impact factor: 1.927. DOI: [10.1109/TNB.2019.2911026](https://doi.org/10.1109/TNB.2019.2911026).
- [16] H. Sajid, N. Jacobs, and S.-c. S. Cheung, “Motion and appearance based background subtraction for freely moving cameras,” *Signal Processing: Image Communication*, 2019, Impact factor: 2.814. DOI: [10.1016/j.image.2019.03.003](https://doi.org/10.1016/j.image.2019.03.003).
- [17] X. Zhang, Y. Zhang, E. Han, N. Jacobs, Q. Han, X. Wang, and J. Liu, “Classification of whole mammogram and tomosynthesis images using deep convolutional neural networks,” *IEEE Transactions on NanoBioscience*, Jul. 2018, Impact factor: 1.927. DOI: [10.1109/TNB.2018.2845103](https://doi.org/10.1109/TNB.2018.2845103).
- [18] N. Jacobs, S. Workman, and R. Souvenir, “Cloudmaps from static ground-view video,” *Image and Vision Computing (IVC)*, vol. 52, pp. 154–166, Aug. 2016, Impact factor: 1.766. DOI: [10.1016/j.imavis.2016.05.013](https://doi.org/10.1016/j.imavis.2016.05.013).
- [19] H. Sajid, S.-c. S. Cheung, and N. Jacobs, “Appearance based background subtraction for PTZ cameras,” *Signal Processing: Image Communication*, Jul. 2016, Impact factor: 1.602. DOI: [10.1016/j.image.2016.07.008](https://doi.org/10.1016/j.image.2016.07.008).
- [20] M. T. Islam, C. Greenwell, R. Souvenir, and N. Jacobs, “Large-scale geo-facial image analysis,” *EURASIP Journal on Image and Video Processing (JIVP)*, vol. 2015, no. 1, pp. 1–14, Jun. 2015, Impact factor: 1.060. DOI: [10.1186/s13640-015-0070-9](https://doi.org/10.1186/s13640-015-0070-9).
- [21] S. Workman, R. Souvenir, and N. Jacobs, “Scene shape estimation from multiple partly cloudy days,” *Computer Vision and Image Understanding (CVIU)*, pp. 116–129, Apr. 2015, Impact factor: 1.54. DOI: [10.1016/j.cviu.2014.10.002](https://doi.org/10.1016/j.cviu.2014.10.002).
- [22] N. Jacobs, A. Abrams, and R. Pless, “Two cloud-based cues for estimating scene structure and camera calibration,” *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, vol. 35, no. 10, pp. 2526–2538, Aug. 2013, Impact factor: 5.694, ISSN: 0162-8828. DOI: [10.1109/TPAMI.2013.55](https://doi.org/10.1109/TPAMI.2013.55).
- [23] N. Jacobs and R. Pless, “Time scales in video surveillance,” *IEEE Transactions on Circuits and Systems for Video Technology (CSVT)*, vol. 18, no. 8, pp. 1106–1113, Aug. 2008, Impact factor: 2.615. DOI: [10.1109/TCSVT.2008.928215](https://doi.org/10.1109/TCSVT.2008.928215).

## Patents

- [1] N. Jacobs and S. Workman, *Network architecture for generating a labeled overhead image*, US Patent App. 16/045,606, Jan. 2020.
- [2] J. A. G. Whitney, J. T. Fessler, Z. C. N. Kratzer, N. B. Jacobs, A. M. Whitney, *et al.*, *Method and system for estimating error in predicted distance using RSSI signature*, Jan. 2016.

## Book Chapters

- [1] R. P. Mihail, N. Jacobs, J. Goldsmith, and K. Lohr, “Using visual analytics to inform rheumatoid arthritis patient choices,” in *Serious Games Analytics*, ser. Advances in Game-Based Learning, C. S. Loh, Y. Sheng, and D. Ifenthaler, Eds., Springer International Publishing, 2015, pp. 211–231, ISBN: 978-3-319-05833-7. DOI: [10.1007/978-3-319-05833-7\\_9](https://doi.org/10.1007/978-3-319-05833-7_9).

## Refereed Conference Papers

- [1] X. Xing, C. Peng, Y. Zhang, A.-L. Lin, and N. Jacobs, “AssocFormer: Association transformer on multi-label classification,” in *British Machine Vision Conference (BMVC)*, Nov. 2022.
- [2] E. Xing, X. Xing, L. Liu, N. Jacobs, Y. Qu, and G. Liang, “Neural network decision-making criteria consistency analysis via inputs sensitivity,” in *International Conference on Pattern Recognition (ICPR 2022)*, Aug. 2022. DOI: [10.1109/ICPR56361.2022.9956394](https://doi.org/10.1109/ICPR56361.2022.9956394).
- [3] S. Workman, M. U. Rafique, H. Blanton, and N. Jacobs, “Revisiting near/remote sensing with geospatial attention,” in *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, Acceptance rate: 25.33%, Jun. 2022. DOI: [10.1109/CVPR52688.2022.00182](https://doi.org/10.1109/CVPR52688.2022.00182).
- [4] X. Xing, G. Liang, Y. Zhang, S. Khanal, A.-L. Lin, and N. Jacobs, “ADViT: Vision transformer on multi-modality pet images for alzheimer disease diagnosis,” in *IEEE International Symposium on Biomedical Imaging (ISBI)*, Mar. 2022. DOI: [10.1109/ISBI52829.2022.9761584](https://doi.org/10.1109/ISBI52829.2022.9761584).
- [5] H. Blanton, S. Workman, and N. Jacobs, “A structure-aware method for direct pose estimation,” in *IEEE Winter Conference on Applications of Computer Vision (WACV)*, Jan. 2022. DOI: [10.1109/WACV51458.2022.00028](https://doi.org/10.1109/WACV51458.2022.00028).
- [6] Y. Zhang, G. Liang, and N. Jacobs, “Dynamic feature alignment for semi-supervised domain adaptation,” in *British Machine Vision Conference (BMVC)*, Nov. 2021.
- [7] G. Liang, X. Xing, L. Liu, Y. Zhang, Q. Ying, A.-L. Lin, and N. Jacobs, “Alzheimer’s disease classification using 2d convolutional neural networks,” in *International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Oct. 2021. DOI: [10.1109/EMBC46164.2021.9629587](https://doi.org/10.1109/EMBC46164.2021.9629587).
- [8] Q. Ying, X. Xing, L. Liu, A.-L. Lin, N. Jacobs, and G. Liang, “Multi-modal data analysis for Alzheimer’s disease diagnosis: An ensemble model using imagery and genetic features,” in *International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Oct. 2021. DOI: [10.1109/EMBC46164.2021.9630174](https://doi.org/10.1109/EMBC46164.2021.9630174).
- [9] Y. Zhang, G. Liang, Y. Su, and N. Jacobs, “Multi-branch attention networks for classifying galaxy clusters,” in *International Conference on Pattern Recognition (ICPR 2020)*, Acceptance rate: 28.47%, Jan. 2021. DOI: [10.1109/ICPR48806.2021.9412498](https://doi.org/10.1109/ICPR48806.2021.9412498).
- [10] G. Liang, Y. Zhang, X. Wang, and N. Jacobs, “Improved trainable calibration method for neural networks,” in *British Machine Vision Conference (BMVC)*, Sep. 2020.
- [11] M. U. Rafique, H. Blanton, N. Snively, and N. Jacobs, “Generative Appearance Flow: A hybrid approach for outdoor view synthesis,” in *British Machine Vision Conference (BMVC)*, Sep. 2020.
- [12] G. Liang, X. Wang, Y. Zhang, and N. Jacobs, “Weakly-supervised self-training for breast cancer localization,” in *International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, (oral), 2020. DOI: [10.1109/EMBC44109.2020.9176617](https://doi.org/10.1109/EMBC44109.2020.9176617).
- [13] T. Salem, S. Workman, and N. Jacobs, “Learning a dynamic map of visual appearance,” in *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Acceptance rate: 25%, 2020. DOI: [10.1109/CVPR42600.2020.01245](https://doi.org/10.1109/CVPR42600.2020.01245).

- [14] S. Workman and N. Jacobs, “Dynamic traffic modeling from overhead imagery,” in *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Acceptance rate: 5.7% (oral), 2020. DOI: [10.1109/CVPR42600.2020.01233](https://doi.org/10.1109/CVPR42600.2020.01233).
- [15] Z. Bessinger and N. Jacobs, “A generative model of worldwide facial appearance,” in *IEEE Winter Conference on Applications of Computer Vision (WACV)*, (oral), 2019. DOI: [10.1109/WACV.2019.00172](https://doi.org/10.1109/WACV.2019.00172).
- [16] G. Liang, S. Fouladvand, J. Zhang, M. A. Brooks, N. Jacobs, and J. Chen, “GANai: Standardizing CT images using generative adversarial network with alternative improvement,” in *IEEE International Conference on Healthcare Informatics (ICHI)*, 2019. DOI: [10.1109/ICHI.2019.8904763](https://doi.org/10.1109/ICHI.2019.8904763).
- [17] G. Liang, X. Wang, Y. Zhang, X. Xing, H. Blanton, T. Salem, and N. Jacobs, “Joint 2d-3d breast cancer classification,” in *IEEE International Conference on Bioinformatics and Biomedicine (BIBM)*, Acceptance rate: 18% (oral), 2019. DOI: [10.1109/BIBM47256.2019.8983048](https://doi.org/10.1109/BIBM47256.2019.8983048).
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- [19] C. Greenwell, S. Workman, and N. Jacobs, “What goes where: Predicting object distributions from above,” in *IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2018. DOI: [10.1109/IGARSS.2018.8519251](https://doi.org/10.1109/IGARSS.2018.8519251).
- [20] N. Jacobs, A. Kraft, M. U. Rafique, and R. D. Sharma, “A weakly supervised approach for estimating spatial density functions from high-resolution satellite imagery,” in *ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (ACM SIGSPATIAL)*, Acceptance rate: 22.5% (oral), 2018. DOI: [10.1145/3274895.3274934](https://doi.org/10.1145/3274895.3274934).
- [21] D. Jones, J. Bopaiah, F. Alghamedy, N. Jacobs, H. Weiss, W. A. D. Jong, and S. Ellingson, “Polypharmacology within the full kinome: A machine learning approach,” in *AMIA Informatics Summit*, 2018.
- [22] R. P. Mihail and N. Jacobs, “Automatic hand skeletal shape estimation from radiographs,” in *IEEE International Conference on Bioinformatics and Biomedicine (BIBM)*, Acceptance rate: 19.6%, 2018. DOI: [10.1109/BIBM.2018.8621196](https://doi.org/10.1109/BIBM.2018.8621196).
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- [24] S. Schuster, M. Zhai, N. Jacobs, and M. Chandraker, “Learning to look around objects for top-view representations of outdoor scenes,” in *European Conference on Computer Vision (ECCV)*, Acceptance rate: 31.8%, 2018. DOI: [10.1007/978-3-030-01267-0\\_48](https://doi.org/10.1007/978-3-030-01267-0_48).
- [25] W. Song, S. Workman, A. Hadzic, R. Souleyrette, E. Green, M. Chen, X. Zhang, and N. Jacobs, “FARSA: Fully automated roadway safety assessment,” in *IEEE Winter Conference on Applications of Computer Vision (WACV)*, 2018. DOI: [10.1109/WACV.2018.00063](https://doi.org/10.1109/WACV.2018.00063).
- [26] M. Zhai, T. Salem, C. Greenwell, S. Workman, R. Pless, and N. Jacobs, “Learning geo-temporal image features,” in *British Machine Vision Conference (BMVC)*, Acceptance rate: 29.5%, 2018.
- [27] N. Vo, N. Jacobs, and J. Hays, “Revisiting IM2GPS in the deep learning era,” in *IEEE International Conference on Computer Vision (ICCV)*, Acceptance rate: 28.9%, 2017. DOI: [10.1109/ICCV.2017.286](https://doi.org/10.1109/ICCV.2017.286).
- [28] S. Workman, R. Souvenir, and N. Jacobs, “Understanding and mapping natural beauty,” in *IEEE International Conference on Computer Vision (ICCV)*, Acceptance rate: 28.9%, 2017. DOI: [10.1109/ICCV.2017.596](https://doi.org/10.1109/ICCV.2017.596).
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- [31] X. Zhang, Y. Zhang, E. Han, N. Jacobs, Q. Han, X. Wang, and J. Liu, “Whole mammogram image classification with convolutional neural networks,” in *IEEE International Conference on Bioinformatics and Biomedicine (BIBM)*, Acceptance rate: 19%, 2017. DOI: [10.1109/BIBM.2017.8217738](https://doi.org/10.1109/BIBM.2017.8217738).
- [32] R. Baltenberger, M. Zhai, C. Greenwell, S. Workman, and N. Jacobs, “A fast method for estimating transient scene properties,” in *IEEE Winter Conference on Applications of Computer Vision (WACV)*, Acceptance rate: 42.3%, 2016, pp. 1–8. DOI: [10.1109/WACV.2016.7477713](https://doi.org/10.1109/WACV.2016.7477713).
- [33] Z. Bessinger and N. Jacobs, “Quantifying curb appeal,” in *IEEE International Conference on Image Processing (ICIP)*, Acceptance rate: 45%, 2016. DOI: [10.1109/ICIP.2016.7533189](https://doi.org/10.1109/ICIP.2016.7533189).
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- [35] R. P. Mihail, S. Workman, Z. Bessinger, and N. Jacobs, “Sky segmentation in the wild: An empirical study,” in *IEEE Winter Conference on Applications of Computer Vision (WACV)*, Acceptance rate: 42.3%, 2016, pp. 1–6. DOI: [10.1109/WACV.2016.7477637](https://doi.org/10.1109/WACV.2016.7477637).
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- [37] S. Workman, M. Zhai, and N. Jacobs, “Horizon lines in the wild,” in *British Machine Vision Conference (BMVC)*, Acceptance rate: 39.4%, 2016.
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- [8] S. Workman and N. Jacobs, *Cross-View ScenicOrNot (CVSoN)*, <https://mvrl.github.io/CVSoN>.
- [9] S. Workman and N. Jacobs, *Crossview USA (CVUSA): A large dataset containing millions of pairs of ground-level and aerial/satellite images from across the United States*. <https://mvrl.github.io/CVUSA>.
- [10] S. Workman, M. Zhai, and N. Jacobs, *Horizon Lines in the Wild (HLW): A large database of images with known horizon-line location*, <http://mvrl.github.io/HLW>.

## 5 Funding

Summary of funding to University of Kentucky as grants, contracts, or unrestricted gifts (Last updated: Nov 23, 2021):

- Total funding: \$10,203,326
  - by role:
    - \* PI: \$4,234,003
    - \* Co-PI/Co-I: \$5,969,323
  - by source:
    - \* Federal: \$9,799,904 (inc. subcontracts on Federal awards)
    - \* Industry: \$199,107
    - \* Foundation: \$159,000
    - \* Internal: \$45,315 (only includes competitively awarded funds)

This excludes a \$28,861,434 NIH CTSA grant, on which I don't deem my contribution essential to the success of this award.

### Grants (awarded/active)

1. *Learning-Based Visual Event Demarcation*  
 PI: **Nathan Jacobs**  
 Co-PI(s)/Co-I(s): Anderson Rocha (UNICAMP)  
 Sponsor: Global Incubator Seed Grant (WashU Internal Funding)  
 Total Award: \$25,000  
 Duration: 2022–2023
2. *WATCH: Wide Area Terrestrial Change Hypercube*  
 PI: **Nathan Jacobs**  
 Sponsor: Kitware / Intelligence Advanced Research Projects Activity (IARPA)  
 Total Award: \$305,941.48 (Phase 1); \$851,489 (Phase 1–3)  
 Duration: 2020–2022 (Phase 1); 2020–2024 (Phase 1–3)

3. *Measures of Information via Representation Learning*  
 PI: Luis Sanchez-Giraldo  
 Co-PI(s)/Co-I(s): **Nathan Jacobs**  
 Sponsor: Department of Defense (DEPSCoR)  
 Total Award: \$582,376  
 Duration: 2021–2024
4. *GeoSearch: Image-based Geolocation using Rank Aggregated Hash Index (Phase 2, direct)*  
 PI: **Nathan Jacobs**  
 Sponsor: Blue Halo / National Geospatial-Intelligence Agency (NGA)  
 Total Award: \$250,000  
 Duration: 2021–2023
5. *Spatio-Temporal Association and Curve Kernel Networks (STACKNet)*  
 PI: **Nathan Jacobs**  
 Sponsor: Blue Halo / MDA  
 Total Award: \$483,000 (Phase 1 and 2)  
 Duration: 2020–2023
6. *Geolocalization Pipeline for Ground Level Images*  
 PI: **Nathan Jacobs**  
 Sponsor: Blue Halo / National Geospatial-Intelligence Agency (NGA)  
 Total Award: \$19,944 (Phase 1), \$249,988 (Phase 2), \$153,261 (Phase 3, Year 1)  
 Duration: 2018–2022

## Grants (completed)

1. *NURI: Semantic Representations for Multi-Viewpoint Multimodal Geolocation*  
 PI: **Nathan Jacobs**  
 Sponsor: Johns Hopkins University, Applied Physics Laboratory / National Geospatial-Intelligence Agency (NGA)  
 Total Award: \$196,000 (base)  
 Duration: 2020–2022
2. *R01: Ex vivo single molecule tools to analyze membrane receptor dynamics*  
 PI: Christopher Richards  
 Co-PI(s)/Co-I(s): Jim Pauly, Ahmed Abdel-Latif, David Heidary, **Nathan Jacobs**  
 Sponsor: National Institutes of Health (NIH)  
 Total Award: \$1,510,803  
 Duration: 2021–2022 (my role ended when I left the University of Kentucky)
3. *UL1: Kentucky Center for Clinical and Translational Science*  
 PI: Philip A. Kern  
 Co-PI(s)/Co-I(s): **Nathan Jacobs** and many others  
 Sponsor: National Institutes of Health (NIH)  
 Total Award: \$28,893,663  
 Duration: 2021–2022 (my role ended when I left the University of Kentucky)
4. *CCT: Context and Colorization for Tracking (Phase 2)*  
 PI: **Nathan Jacobs**  
 Sponsor: Intelligent Automation Inc. / Defense Advanced Research Projects Agency (DARPA)  
 Total Award: \$200,000  
 Duration: 2020–2021



5. *Video to Feature Data Association and Geolocation*  
PI: **Nathan Jacobs**  
Sponsor: Novateur Research Solutions / National Geospatial-Intelligence Agency (NGA)  
Total Award: \$29,503 (Phase 1), \$149,883 (Phase 2)  
Duration: 2018–2021
6. *CAREER: Learning and Using Models of Geo-Temporal Appearance*  
PI: **Nathan Jacobs**  
Sponsor: National Science Foundation (NSF)  
Total Award: \$499,426  
Duration: 2016–2021
7. *R01: Monomeric G-proteins and Cardioprotection from Heart Failure*  
PI: John Satin  
Co-PI(s)/Co-I(s): Douglas Andres, Ahmed Abdel-Latif, **Nathan Jacobs**, Peter Kekenyes-Huskey  
Sponsor: National Institutes of Health (NIH)  
Total Award: \$1,575,279  
Duration: 2016–2020
8. *Group Travel Grant for the Doctoral Consortium to be Held in Conjunction with IEEE Conference on Computer Vision and Pattern Recognition*  
PI: **Nathan Jacobs**  
Sponsor: National Science Foundation (NSF)  
Total Award: \$22,500  
Duration: 2019–2020
9. *DLALA: Deep Learning for Airborne LiDAR Analysis*  
PI: **Nathan Jacobs**  
Sponsor: Orbital Insight  
Total Award: \$104,927  
Duration: 2019–2020
10. *Listening to Markets: A Temporal Convolutional Net (TCN) Analysis of Conservatism in Company Reporting*  
PI: Dan Stone  
Co-PI(s)/Co-I(s): **Nathan Jacobs**, Mark Lauersdorf, Hong Xie  
Sponsor: University of Kentucky  
Total Award: \$33,315  
Duration: 2018–2019
11. *Calibrated Pose Regression Networks*  
PI: **Nathan Jacobs**  
Sponsor: The Design Knowledge Company / Air Force Research Lab (Wright-Patterson AFB)  
Total Award: \$155,700 (Phase 3)  
Duration: 2018–2019
12. *Group Travel Grant for the PhD Forum to be Held in Conjunction with IEEE Winter Conference on Applications of Computer Vision*  
PI: **Nathan Jacobs**  
Sponsor: National Science Foundation (NSF)  
Total Award: \$13,625  
Duration: 2018–2019
13. *ASER Multi Center Review of Blunt Splenic Trauma: Optimal CT Diagnosis, Characterization*  
PI: James Lee (Radiology)

Co-PI(s)/Co-I(s): David Nickels, **Nathan Jacobs**, Emily Slade

Sponsor: American Society of Emergency Radiology

Total Award: \$5,000

Duration: 2018–2019

14. *Mechanism of a Novel Stable Compensatory Cardiac Hypertrophy Model*

PI: Jonathan Satin

Co-PI(s)/Co-I(s): Douglas Andres, **Nathan Jacobs**, Moriel Vandsburger

Sponsor: American Heart Association

Total Award: \$154,000

Duration: 2016–2018

15. *NIP: GeoLookbook: Modeling Worldwide Human Visual Appearance*

PI: **Nathan Jacobs**

Sponsor: National Geospatial-Intelligence Agency (NGA)

Total Award: \$299,204

Duration: 2014–2018

16. *Crossview ConvNets for Near/Remote Sensing*

PI: **Nathan Jacobs**

Sponsor: Google

Total Award: \$46,209

Duration: 2016–2017

17. *WALDO: Wide Area Localization of Depicted Objects*

PI: **Nathan Jacobs**

Sponsor: Object Video / Intelligence Advanced Research Projects Activity (IARPA)

Total Award: \$373,395

Duration: 2012–2016

18. *CSSG: ContextualEyes: A Context-Aware Surveillance System*

PI: **Nathan Jacobs**

Sponsor: Defense Advanced Research Projects Agency (DARPA)

Total Award: \$743,131

Duration: 2011–2015

19. *Image-Net: Discriminatory Imaging and Network Advancement for Missiles, Aviation, and Space*

PI: Brent Seales

Co-PI(s)/Co-I(s): Ken Calvert, James Griffioen, Jane Hayes, **Nathan Jacobs**, Victor Marek, Thomas Seigler, Suzanne Smith, Mirosław Truszczyński, Ruigang Yang

Sponsor: United States Army Space and Missile Defense Command / United States Army Forces Strategic Command

Total Award: \$2,092,905

Duration: 2011–2012

## Donations

1. *Google Cloud Compute Research Credits*

Sponsor: Google

Amount/Value: \$5,000

PI: **Nathan Jacobs**

Date: Aug 2018

2. *NVIDIA Titan X GPU*

Sponsor: NVIDIA

Amount/Value: \$778

PI: **Nathan Jacobs**

Date: Oct 2016

3. <i>AWS Research Education Grant</i>	PI: <b>Nathan Jacobs</b>
Sponsor: Amazon	Date: Jul 2015
Amount/Value: \$5,000	
4. <i>NVIDIA Tesla K40 GPU</i>	PI: <b>Nathan Jacobs</b>
Sponsor: NVIDIA	Date: Dec 2014
Amount/Value: \$3,900	

## 6 Talks

1. “Domain-Inspired Deep Learning for Computer Vision, Remote Sensing, and Medical Imaging”, Oct 2022, Imaging Science Seminar, Washington University, St. Louis, MO
2. “Computer Vision for Multimodal Remote Sensing”, Aug 2022, WashU Geospatial Working Group Research Workshop, Washington University, St. Louis, MO
3. “A Structure-Aware Method for Direct Pose Estimation”, Jan 2022, IEEE Winter Conference on Applications of Computer Vision (WACV), Waikoloa Village, HI
4. Panelist for “Non-Traditional Careers in Computer Science” Nov 2021, ACM-W, University of Kentucky, Lexington, KY
5. “Mapping the Visual World Using Webcams, Cell Phones, and Satellites”, Oct 2021, Washington University in St. Louis, MO
6. “Learning Geo-Temporal Scene Models from Webcams, Cell Phones, and Satellites” (Keynote), Oct 2021, International Workshop on Distributed Smart Cameras, an ICCV Workshop (virtual)
7. “Mapping the Visual World Using Webcams, Cell Phones, and Satellites”, Dec 2020, University of Campinas, Unicamp, Brazil (virtual)
8. “Exploring the Intersection of Localization, Mapping, and Image Understanding” (Keynote), Aug 2020, ECCV Workshop on Long-Term Visual Localization (virtual)
9. “Deep Convolutional Neural Networks: Foundations to Frontiers (a 2-day short course)”, Mar 2020, Brazilian Space Agency (INPE), Sao Jose dos Campos, Brazil
10. “What, Where, and When: Mapping the World Using Webcams, Cell Phones, and Satellites”, Mar 2020, Brazilian Space Agency (INPE), Sao Jose dos Campos, Brazil
11. “Learning to Map Visual Appearance”, Feb 2020, Keeping Current Seminar, University of Kentucky (Computer Science), Lexington, KY
12. “Learning to Map Visual Appearance”, Jan 2020, Wageningen University, Netherlands
13. “What, Where, and When: Mapping the World Using Webcams, Cell Phones, and Satellites”, Nov 2019, University of Kentucky (Forestry), Lexington, KY
14. “Learning to Map the Visual World”, Jul 2019, Wright State University, Dayton, OH
15. “Understanding Places Using Ground-Level and Overhead Views” (Keynote), May 2019, Kentucky Geological Society (Annual Symposium), Lexington, KY
16. “Understanding Places Using Ground-Level and Overhead Views”, Feb 2019, Notre Dame University, South Bend, IN
17. “A Generative Model of Worldwide Facial Appearance” (Keynote), Jan 2019, Workshop on Demographic Variations in Performance of Biometric Algorithms, Waikoloa Village, HI

18. “A Generative Model of Worldwide Facial Appearance”, Jan 2019, IEEE Winter Conference on Applications of Computer Vision, Waikoloa Village, HI
19. “A Weakly Supervised Approach for Estimating Spatial Density Functions from High-Resolution Satellite Imagery”, Nov 2018, ACM SIGSPATIAL, Seattle, WA
20. “Understanding Places Using Ground-Level and Overhead Views”, Oct 2018, Commonwealth Computational Summit, Lexington, KY
21. “GeoLookbook: Modeling Worldwide Human Visual Appearance (Year 4)”, Sep 2018, National Academy of Sciences (IC Academic Research Symposium), Washington, DC
22. “Understanding Places Using Ground-Level and Overhead Views”, Aug 2018, Oak Ridge National Lab, Oak Ridge, TN
23. “WhatGoesWhere: Predicting Object Distributions from Above”, Jul 2018, IGARSS, Valencia, Spain
24. “Building World Models for Situated Training and Planning”, May 2018, Air Force Science and Technology 2030 Workshop, Bloomington, IN
25. “Recent Advances in Image Understanding”, May 2018, DASC, Lexington, KY
26. “(Tutorial) Recent Advances in Deep Learning: Fusing Overhead and Ground-Level Views for Remote Sensing”, April 2018, USGIF Annual Symposium, Tampa, FL
27. “Understanding Places Using Ground-Level and Overhead Views”, Feb 2018, CVPR Area Chair Meeting, Toronto, Canada
28. “GeoLookbook: Modeling Worldwide Human Visual Appearance (Year 3)”, Sep 2017, National Academy of Sciences (IC Academic Research Symposium), Washington, DC
29. “GPU Accelerated Computer Vision, Remote Sensing, and Machine Learning”, Aug 2017, Kentucky Geological Service, Lexington, KY
30. “Fusing Overhead and Ground-Level Imagery to Improve Scene Understanding”, Jul 2017, Planet, San Francisco, CA
31. “Learning about When and Where from Imagery”, Jun 2017, Orbital Insight, Mountain View, CA
32. “(Tutorial) Recent Advances in Deep Learning: Fusing Overhead and Ground-Level Views for Remote Sensing”, Jun 2017, USGIF Annual Symposium, San Antonio, TX
33. “How Computers See People (extended)”, May 2017, CCTS Biomedical Informatics Seminar Series, Lexington, KY
34. “Understanding Places Using Ground-Level and Overhead Views”, May 2017, Midwest Vision Meeting, Chicago, IL
35. “How Computers See People”, Feb 2017, Suds’n’Science Speaker Series, West Sixth Brewing, Lexington, KY
36. “Learning about When and Where from Imagery”, Feb 2017, University of Missouri, Department of Computer Science
37. “Localization, Mapping, and Image Understanding”, Feb 2017, USGIF Machine Learning Symposium
38. “Deep Convolutional Neural Networks: Concepts and Examples (in Computer Vision)”, Nov 2016, University of Kentucky, Society of Industrial and Applied Mathematics

39. “Crossview Convolutional Networks”, Oct 2016, Applied Imagery and Pattern Recognition, Washington, D.C.
40. “GeoLookbook: Modeling Worldwide Human Visual Appearance (Year 2)”, Sep 2016, National Academy of Sciences (IC Academic Research Symposium), Washington, DC
41. “Deep Convolutional Neural Networks: Concepts and Examples”, Jul 2016, University of Kentucky: Systems Biology and Omics Integration Seminar
42. “Crossview Methods for Localization and Mapping”, Jun 2016, IEEE CVPR Workshop on “Vision from Satellite to Street” (invited talk)
43. “A Fast Method for Estimating Transient Scene Properties”, Mar 2016, Winter Conference on Applications of Computer Vision, Lake Placid, NY
44. “Novel Cues for Geocalibration”, Feb 2016, Indiana University, Bloomington, IN
45. “Novel Cues for Camera Geocalibration”, Jan 2016, Uber Advanced Technology Center, Pittsburgh, PA
46. “Novel Cues for Geocalibration: Cloudy Days, Rainbows, and More”, Oct 2015, Carnegie Mellon University, Pittsburgh, PA
47. “Using Geotagged Internet Imagery to Understand the World”, Sep 2015, Université Laval, Quebec City, Canada
48. “face2gps: Estimating Geographic Location from Facial Features”, Sep 2015, International Conference on Image Processing, Quebec City, Canada
49. “GeoLookbook: Modeling Worldwide Human Visual Appearance”, Sep 2015, National Academy of Sciences (IC Academic Research Symposium), Washington, DC
50. “Exploring the Geo-Dependence of Human Face Appearance”, Mar 2014, Winter Conference on Applications of Computer Vision, Steamboat Springs, CO
51. “Estimating Cloudmaps from Outdoor Image Sequences”, Mar 2014, Winter Conference on Applications of Computer Vision, Steamboat Springs, CO
52. “Scene Geometry from Several Partly Cloudy Days”, Oct 2013, International Conference on Distributed Smart Cameras, Palm Springs, CA
53. “Unlocking the Potential of the Global Network of Outdoor Webcams”, Apr 2013, Rochester Institute of Technology
54. “Geo-temporal Computer Vision: Applications to the NGA”, Nov 2011, National Geospatial-Intelligence Agency
55. “Geo-temporal Computer Vision: Applications to the Army”, Oct 2011, Army Research Lab
56. “Localizing, Calibrating, and Using Thousands of Outdoor Webcams”, Feb 2011, University of North Carolina–Charlotte
57. “Using Clouds Shadows to Infer Scene Structure and Camera Calibration”, Jun 2010, CVPR, San Francisco, CA
58. “Passive Vision and The Power of Collective Imaging”, Apr 2010, Object Video Inc., Reston, VA
59. “Localizing, Calibrating, and Using Thousands of Outdoor Webcams”, Apr 2010, University of Kentucky
60. “Time-Lapse Vision: Localizing, Calibrating, and Using Thousands Outdoor Webcams”, Apr 2010, Google, Mountain View, CA
61. “Passive Vision and The Power of Collective Imaging”, Jan 2010, Google, Mountain View, CA

62. “Incorporating Domain Constraints in Urban Vehicle Tracking”, Nov 2010, University of Missouri, Columbia, MO
63. “Compressive Sensing and Differential Image-Motion Estimation”, Mar 2010, ICASSP, Dallas, TX
64. “The Global Network of Outdoor Webcams: Properties and Applications ”, Nov 2009, ACM GIS, Seattle, WA
65. “Passive Vision: The Global Webcam Imaging Network”, Oct 2009, AIPR, Washington, DC
66. “Calibrating and Using the Global Network of Outdoor Webcams”, Aug 2009, ICDSC, Italy
67. “Adventures in Archiving and Using Three Years of Webcam Images”, Jun 2009, CVPR Workshop on Internet Vision, Miami, FL
68. “Recent Work: Webcams and Grooves”, Aug 2009, Object Video, Reston, VA
69. “Location-Specific Models for Tracking”, Jan 2008, WMVC, Copper Mountain, CO
70. “Using natural cues to geo-locate and geo-orient distributed cameras”, Jan 2008, VISN, Copper Mountain, CO
71. “Foreground Modeling: The Shape of Things That Came”, Feb 2007, WMVC, Austin, Texas

## 7 Service

### University Service

- Washington University in St. Louis (2022–present)
  - 2023–present: Faculty Advisor, WashU Robomaster Club
  - 2023–present: Faculty Technology Advisory Committee, James McKelvey School of Engineering
  - 2022–present: Strategic Planning Steering Committee, James McKelvey School of Engineering
  - 2022–present: Leadership Team, Geospatial Working Group
  - 2022–present: Research Council, Taylor Geospatial Institute
  - 2022–2023: Faculty Search Committee, Computer Science & Engineering Department
- University of Kentucky (2010–2022)
  - 2021–2022: Institute for Biomedical Informatics: Steering Committee
  - 2019–2022: Computer Science Department: Executive Committee
  - 2019–2022: College of Engineering: Master Planning/Space Committee
  - 2018–2019, 2020–2022: College of Engineering: Research Advisory Committee
  - 2020–2022: College of Engineering: Graduate Studies Team
  - 2013–2017, 2018–2022: Computer Science Department: Faculty Search Committee
  - 2020–2021: Computer Science Department: Chair Search Committee
  - 2020: College of Engineering: Recruiting Advisory Committee
  - 2018–2019: University Senate (Academic Facilities Committee, Technology Committee)
  - 2017: Member (Information Technology Task Force for Research Enablement and Outreach)
  - 2015–2016: Computer Science Department: ABET Committee
  - 2010–2012, 2015–2016: Computer Science Department: Media and Outreach
  - 2013: Center for Visualization and Virtual Environment: Director Search Committee
  - 2013: Computer Science Department: Chair Search Committee
  - 2012–2013: Computer Science Department: Curriculum Development Committee
  - 2012–2013, 2015: Engineering Day (oral presentation and/or software demonstration)



## Professional Service

- Area Chair:
  - IEEE Conference on Computer Vision and Pattern Recognition (CVPR) [2018, 2019, 2021, 2023]
  - IEEE International Conference on Computer Vision (ICCV) [2023]
  - European Conference on Computer Vision (ECCV) [2022]
  - IEEE Winter Conference on Applications of Computer Vision (WACV) [2014, 2022 (round 2), 2023]
- Organizing Committees:
  - Industrial/Government Relations Chair: IEEE Winter Conference on Applications of Computer Vision (WACV) [2024]
  - IEEE/ISPRS Workshop on Large Scale Computer Vision for Remote Sensing Imagery (EARTHVISION) [2019, 2020, 2021, 2022, 2023]
  - Doctoral Consortium Co-Chair: IEEE Conference on Computer Vision and Pattern Recognition (CVPR) [2017, 2019]
  - Doctoral Consortium Chair: IEEE Winter Conference on Applications of Computer Vision (WACV) [2018, 2022]
  - Video Proceedings Chair: IEEE Conference on Computer Vision and Pattern Recognition (CVPR) [2015]
  - IEEE Workshop on Motion and Video Computing (WMVC) [2011]
- Guest Editor:
  - IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (J-STARS) [2021], Special Issue “Integrating User Generated Contents for Remote Sensing Applications”
  - Elsevier Computer Vision and Image Understanding (CVIU) [2019], Special Issue “Computer Vision for Remote Sensing”
- Session Chair:
  - IEEE International Geoscience and Remote Sensing Symposium (IGARSS) [2020]
  - IEEE/ISPRS Workshop on Large Scale Computer Vision for Remote Sensing Imagery (EARTHVISION) [2019]
  - IEEE Winter Conference on Applications of Computer Vision (WACV) [2016, 2019, 2022]
  - IEEE Conference on Computer Vision and Pattern Recognition (CVPR) [2018]
  - IEEE/ACM International Conference on Distributed Smart Cameras [2013]
- Reviewing for Journals:
  - IEEE Transactions on Geoscience and Remote Sensing [2020]
  - ISPRS Journal of Photogrammetry and Remote Sensing [2020]
  - IEEE Transactions on Pattern Analysis and Machine Intelligence [2011, 2011, 2012, 2018, 2019]
  - ISPRS Journal of Photogrammetry and Remote Sensing [2019]
  - IEEE Transactions on Geoscience and Remote Sensing [2017]
  - IEEE Transactions on Multimedia [2011, 2016]
  - Elsevier Computer Vision and Image Understanding [2010, 2013, 2016×2]
  - IEEE Transactions on Computational Imaging [2016]

- IEEE Journal on Selected Topics in Remote Sensing [2015]
- Springer Machine Vision and Applications [2014]
- IEEE Sensors [2014]
- Elsevier Image and Vision Computing [2013]
- IEEE Transactions on Circuits and Systems for Video Technology [2007, 2008, 2009, 2010, 2011]
- IEEE Computer Graphics and Applications [2010]
- IEEE Transactions on Aerospace and Electronic Systems [2010]
- Elsevier Computers and Electronics in Agriculture [2010]
- Cartography and Geographic Information Science [2010]
- Program Committee / Reviewer for:
  - Conferences
    - \* International Conference on Learning Representations (ICLR) [2022]
    - \* IEEE Winter Conference on Applications of Computer Vision (WACV) [2021]
    - \* IEEE International Geoscience and Remote Sensing Symposium (IGARSS) [2020]
    - \* British Machine Vision Conference (BMVC) [2020]
    - \* IEEE Conference on Computer Vision and Pattern Recognition (CVPR) [2006–2017, 2020]
    - \* European Conference on Computer Vision (ECCV) [2010, 2014, 2020]
    - \* Neural Information Processing Systems (NeurIPS) [2010–2012, 2020]
    - \* AAAI Conference on Artificial Intelligence (AAAI) [2020]
    - \* IEEE International Conference on Computer Vision (ICCV) [2007, 2009, 2019, 2021]
    - \* Asian Conference on Computer Vision (ACCV) [2010, 2016]
    - \* IEEE International Conference on Robotics and Automation (ICRA) [2016]
    - \* International Conference on Machine Learning (ICML) [2012]
    - \* IEEE International Conference on Advanced Video and Signal-Based Surveillance (AVSS) [2010]
  - Workshops
    - \* ICLR Workshop on Machine Learning for Remote Sensing [2023]
    - \* IEEE/ISPRS Workshop on Large Scale Computer Vision for Remote Sensing Imagery (EARTHVISION) [2017, 2019, 2020]
    - \* CVPR Workshop on Photogrammetric Computer Vision [2019]
    - \* CVPR Workshop on DeepGlobe Satellite Challenge [2018]
    - \* ACM International Workshop on Geotagging and Its Applications [2013]
    - \* ICCV Workshop on Computer Vision for Converging Perspectives [2013]
    - \* IEEE Workshop on Applications of Computer Vision [2012–2013]
    - \* ECCV Workshop on Visual Analysis and Geo-Localization of Large-Scale Imagery [2012]
    - \* ACM Workshop on Geotagging and Its Applications in Multimedia [2012]
    - \* IEEE Workshop on Motion and Video Computation [2009–2011]
- Reviewing for Funding Agencies:
  - Panelist for NSF Information and Intelligent Systems Division [2019]
  - Panelist for NSF Information and Intelligent Systems Division [2018]
  - Panelist for NSF Information and Intelligent Systems Division [2017]

- Panelist for NSF Division of Industrial Innovation and Partnerships [2016]
- Panelist for NSF Information and Intelligent Systems Division [2016]
- Panelist for NSF Information and Intelligent Systems Division [2015]
- External reviewer for NSF Information and Intelligent Systems Division [2015]
- External reviewer for Fonds de recherche du Quebec [2014]

## Memberships

- Senior Member: Institute of Electrical and Electronics Engineers
- Full Member: British Machine Vision Association and Society for Pattern Recognition
- Affiliate Member: International Association of Pattern Recognition

## 8 Teaching and Mentoring

### Courses Taught

The following list summarizes the traditional, classroom courses I have taught:

- *Computer Vision*, CSE 559a, [S2023], Washington University in St. Louis
- *Machine Learning*, CS 460g, [F2012, F2013, F2014, F2016, F2018, F2019], University of Kentucky
- *Computer Vision*, CS 636, [S2011, S2013, S2017], University of Kentucky
- *Learning-Based Methods for Computer Vision*, CS 585/685, [S2015], University of Kentucky
- *Advanced Topics in Computer Science: Machine Learning*, CS 685, [S2012], University of Kentucky
- *Intermediate Topics in Computer Science: Computational Photography*, CS 585, [F2010, F2011], University of Kentucky
- *Theory of Computation*, CECS 341, [F2002], University of Missouri

The following list summarizes the independent study courses (UKy CS 395 or 612) I have supervised:

- F2019, “Applied Deep Learning”
- S2019, “Applied Deep Learning” (×5)
- F2018, “Applied Deep Learning” (×5)
- S2018, “Applied Deep Learning” (×4)
- F2017, “Applied Deep Learning”
- F2016, “Applied Deep Learning” (×6)
- S2016, “Applied Deep Learning: Understanding Urban Areas”
- S2015, “Understanding Real-Estate Imagery”
- F2014, “Recent Techniques in Machine Learning” (×4)
- F2014, “Learning-Based Methods for Background Subtraction”

- F2014, “A Novel Approach for Category-Level Object Detection from Partial Pose Estimation of Symmetric Objects”
- S2013, “Extracting Geo-Temporal Image Appearance Patterns from Flickr Imagery”
- S2013, “Automatic Camera Calibration Methods”
- S2013, “Deep-Learning Architectures for Computer Vision”
- F2012, “Automatic Image Geolocalization”
- S2012, “Image Calibration using Natural Scene Variations”
- F2011, “Practical Methods in Crowd Sourcing”

## Mentoring

### Postdoctoral Scholars

1. Adeel Ahmad (Ph.D. Geomatics, University of Punjab–Lahore) Dates: 2023–present  
Research Focus: Remote Sensing, Deep Learning, Land-Use Modeling
2. Benjamin Brodie (Ph.D. Mathematics, University of Kentucky) Dates: 2020–2022  
Research Focus: Change Detection, Object Tracking, Re-Identification, Metric Learning  
Employment: Research Scientist, Blue Halo

### Ph.D. Students

1. [Paul Mihail](#) [*co-chair w/ Judy Goldsmith*] Degree: Ph.D., Computer Science  
Title: Visualizing and Predicting the Effects of Rheumatoid Arthritis on Hands Date: May 2014  
Employment: Associate Professor, Computer Science, Valdosta State University
2. [Mohammad T. Islam](#) Degree: Ph.D., Computer Science  
Title: Analyzing the Geo-Dependence of Human Face Appearance and Its Applications Date: Jul 2016  
Employment: Associate Professor, Computer Science, Southern Connecticut State University
3. [Hamid Hamraz](#) Degree: Ph.D., Computer Science  
Title: Computational Forest Modeling using Airborne Remote Sensing LiDAR Date: Apr 2018  
Employment: Computational and Data Scientist, Microsoft
4. [Scott Workman](#) Degree: Ph.D., Computer Science  
Title: Leveraging Overhead Imagery for Localization, Mapping, and Understanding Date: Apr 2018  
Employment: Research Scientist, DZYNE Technologies
5. Menghua “Ted” Zhai Degree: Ph.D., Computer Science  
Title: Deep Probabilistic Models for Camera Geo-Calibration Date: Dec 2018  
Employment: Computer Vision Engineer, MatrixTime (startup)
6. [Zach Bessinger](#) Degree: Ph.D., Computer Science  
Title: Modeling and Mapping Location-Dependent Human Appearance Date: Dec 2018  
Employment: Senior Applied Scientist, Zillow
7. [Tawfiq Salem](#) Degree: Ph.D., Computer Science  
Title: Learning to Map the Visual and Auditory World Date: Jul 2019  
Employment: Visiting Assistant Professor, Computer and Information Technology, Purdue University

8. [Gongbo Liang](#) Degree: Ph.D., Computer Science  
 Title: Clinical-Inspired Multi-Modal Deep Learning Medical Imaging Analysis Date: Oct 2020  
 Employment: Assistant Professor, Computer Science, Eastern Kentucky University
9. [Usman Rafique](#) [*co-chair* w/ Samson Cheung] Degree: Ph.D., Electrical Engineering  
 Title: Weakly Supervised Learning for Multi-Image Synthesis Date: Jul 2021  
 Employment: Research Scientist, Kitware Inc.
10. [Hunter Blanton](#) Degree: Ph.D., Computer Science  
 Title: Revisiting Absolute Pose Regression Date: Aug 2021  
 Employment: Senior Computer Vision Engineer, Yembo (startup)
11. [Connor Greenwell](#) Degree: Ph.D., Computer Science  
 Title: Probabilistic Cross-Domain Representation Learning Date: Jun 2022  
 Employment: Senior R&D Engineer, Kitware Inc.
12. [Yu Zhang](#) Degree: Ph.D., Computer Science  
 Title: Multimodal Domain Generalization Date: Mar 2023 (est)
13. Xin Xing [*co-chair* w/ Ai-Ling Lin] Degree: Ph.D., Computer Science  
 Title: TBD [Medical Imaging and Attention] Date: Dec 2023 (est)
14. Subash Khanal Degree: Ph.D., Computer Science  
 Title: TBD Date: Jun 2024 (est)
15. Oscar Skean [*co-chair* w/ Luis Sanchez-Giraldo] Degree: Ph.D., Computer Science  
 Title: TBD [Information-Theoretic Metric Learning] Date: May 2024 (est)
16. Aayush Dhakal Degree: Ph.D., Computer Science  
 Title: TBD Date: May 2026 (est)
17. Lydia Reader [*co-chair* w/ Ross Hammond] Degree: Ph.D., Computational & Data Sciences  
 Title: TBD Date: May 2026 (est)
18. Srikumar Sastry Degree: Ph.D., Imaging Science  
 Title: TBD Date: May 2027 (est)
19. Michael Lanier [*co-chair* w/ Yevgeniy Vorobeychik] Degree: Ph.D., Computer Science  
 Title: TBD Date: May 2027 (est)
20. Zhexiao Xiong Degree: Ph.D., Computer Science  
 Title: TBD Date: May 2027 (est)

## Masters Students

1. Feiyu Shi Degree: MS, Computer Science  
 Title: Principal Component Analysis For Multi-size Images Date: Dec 2013  
 Employment: Senior Software Engineer, Microsoft
2. Ryan Baltenberger Degree: MS, Computer Science  
 Title: Estimating Transient Scene Attributes Using Deep Convolutional Neural Networks Date: May 2016  
 Employment: Computer Vision Research Engineer, Badger Technologies
3. William “Derek” Jones [*co-chair* w/ Sally Ellingson] Degree: MS, Computer Science  
 Title: Scalable Feature Selection and Extraction with Applications in Kinase Polypharmacology Date: May 2018  
 Employment: Research Data Scientist, Lawrence Livermore National Laboratory, ATOM

4. [Weilian “William” Song](#) Degree: MS, Computer Science  
Title: Image-Based Roadway Assessment using Convolutional Neural Networks Date: May 2019  
Employment: Ph.D. student, Simon Fraser University
5. [Armin Hadzic](#) Degree: MS, Computer Science  
Title: Estimating Free-Flow Speed with LiDAR and Overhead Imagery Date: May 2020  
Employment: Machine Learning Research Scientist, DZYNE Technologies
6. David Jones Degree: MS, Computer Science  
Title: Intensity Harmonization for Airborne LiDAR Date: May 2021  
Employment: Machine Learning Engineer, Kinetic Vision
7. Jacob Birge Degree: MS, Computer Science  
Title: A Cost-Sensitive Approach To Multimodal Fusion Date: Dec 2021  
Employment: UPS
8. Alex Wollam Degree: MS, Computer Science  
Title: Cross-View Image Synthesis Date: May 2023
9. Nia Hodges Degree: MS, Engineering Data Analytics & Statistics  
Title: Wide-Area Image Localization Date: May 2024

## Undergraduate Research Students

1. Jim Knochelmann Dates: 2011–2012  
Title: User-Tools for Aerial Image Registration
2. Kyle Kolpek Dates: 2012  
Title: Aerial Image Registration
3. Noora Aljabi Dates: 2013  
Title: Using Flickr to Map Phenological Trends
4. J. David Smith Dates: 2013–2015  
Title: User-in-the-loop Camera Calibration
5. Angelo Stekardis Dates: 2014–2015  
Title: Understanding Facial Expressions
6. Ryan Baltenberger Dates: 2012–2015  
Title: Understanding Outdoor Scene Appearance
7. Connor Greenwell Dates: 2014–2016  
Title: Interactive Methods for Aerial Imagery Understanding
8. Sam Davidson Dates: 2016–2017  
Title: Applications of Generative Adversarial Networks to Social Media Imagery
9. Aaron Mueller Dates: 2018  
Title: Deep Learning for Educational Data
10. Weilian Song Dates: 2016–2019  
Title: Applications of Deep Convolutional Neural Networks to Geometric Computer Vision
11. Yuhao Long Dates: 2019  
Title: Deep Learning for Medical Imaging



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|---|------------------|
| 12. Thomas Barber   | Dates: 2019      |
| Title: Deep Learning for Remote Sensing                       |                  |
| 13. Sean Grate  | Dates: 2019–2020 |
| Title: Deep Learning for Point Clouds                         |                  |
| 14. Shashank Bhatt  | Dates: 2020–2022 |
| Title: Multi-Object Tracking                                  |                  |
| 15. Evan Bolton   | Dates: 2021      |
| Title: Generating Synthetic Training Data using a Game Engine |                  |
| 16. Julia Stekardis   | Dates: 2021–2022 |
| Title: Large-Scale Image Geo-Localization                     |                  |
| 17. Gareth Walker   | Dates: 2022      |
| Title: Remote Sensing for Social Good                         |                  |
| 18. Matthew Mitchell  | Dates: 2022      |
| Title: Remote Sensing for Social Good                         |                  |
| 19. Cohen Archbold  | Dates: 2020–2022 |
| Title: Automatic Real-Estate Price Estimation                 |                  |

## High School Research Students

- |   |                  |
|---|------------------|
| 1. Ryan Baltenberger  | Dates: 2011–2012 |
| Title: Gesture-Based User Interaction with the Microsoft Kinect                     |                  |
| 2. Alex Lucas   | Dates: 2014–2013 |
| Title: Evaluation of Automatic Face Detection Methods                               |                  |
| 3. Andrew Tapia   | Dates: 2014–2015 |
| Title: Estimating Surface Reflectivity  |                  |
| 4. Andrew Albrecht  | Dates: 2016–2017 |
| Title: Mapping Social Media Imagery   |                  |
| 5. C. J. Labianca   | Dates: 2016–2017 |
| Title: Evaluation of Optimization Algorithms for Deep Convolutional Neural Networks |                  |
| 6. Ryan Landry  | Dates: 2017–2018 |
| Title: RRADCL: Rapid Roadway Assessment with Deep Convolutional Learning            |                  |
| 7. Cohen Archbold   | Dates: 2017–2018 |
| Title: Photo-Geolocation using Convolutional Neural Networks                        |                  |
| 8. Nicole Wong  | Dates: 2019–2020 |
| Title: Learning-Based View Synthesis  |                  |
| 9. Chris Wang   | Dates: 2019–2021 |
| Title: Multimodal Medical Imaging for Alzheimer’s Disease Classification            |                  |
| 10. William Greenlee  | Dates: 2021–2022 |
| Title: Deep Learning for Computer Vision  |                  |
| 11. Krishna Bhatraju  | Dates: 2021–2022 |
| Title: Deep Motion Estimation   |                  |

## Graduate Committees (as regular member or external examiner)

1. Edwin Prem Kumar Sathiyamoorthy  
Role: member  
Title: Global Change Reactive Background Subtraction  
Degree: M.S., Electrical Engineering  
Date: Mar 2011
2. Ju Shen  
Role: member  
Title: Computational Multimedia for Video Self Modeling  
Degree: Ph.D., Electrical Engineering  
Date: May 2014
3. Hasan Sajid  
Role: member  
Title: A Universal Background Subtraction System  
Degree: M.S., Electrical Engineering  
Date: Jul 2014
4. Chenxi Zhang  
Role: member  
Title: Depth-assisted Image Segmentation, Enhancement and Visualization  
Degree: Ph.D., Computer Science  
Date: Dec 2014
5. Mao Ye  
Role: member  
Title: 3D Reconstruction and Motion Analysis of Deformable Objects with Consumer Depth Cameras  
Degree: Ph.D., Computer Science  
Date: Dec 2014
6. Yan Huang  
Role: member  
Title: Novel Computational Methods for Transcript Reconstruction and Quantification using RNA-SEQ Data  
Degree: Ph.D., Computer Science  
Date: Dec 2014
7. Shaoceng Wei  
Role: outside examiner  
Title: Multi-state Models for Interval Censored Data with Competing Risk  
Degree: Ph.D., Statistics  
Date: May 2015
8. Bo Fu  
Role: member  
Title: Towards Intelligent Telerobotics: Visualization and Control of Remote Robot  
Degree: Ph.D., Computer Science  
Date: May 2015
9. Harikrishnan Unnikrishnan  
Role: member  
Title: Analysis of Vocal Fold Kinematics using High Speed Video  
Degree: Ph.D., Electrical Engineering  
Date: Dec 2015
10. Sean Karlage  
Role: member  
Title: Diachronic Volume Registration for Analysis of Antiquities  
Degree: M.S., Computer Science  
Date: May 2016
11. Hasan Sajid  
Role: member  
Title: Robust Background Subtraction for Moving Cameras and their Applications in Ego-vision Systems  
Degree: Ph.D., Electrical Engineering  
Date: Jul 2016
12. Stanley Rosenbaum  
Role: member  
Title: A method for presenting volume and color of 3D objects via audio for the visually impaired  
Degree: M.S., Computer Science  
Date: Dec 2016
13. DhiShankar Bhattacharya  
Role: member  
Title: Analyzing Sybil Attacks and Similar Phenomena in Twitter Data  
Degree: M.S., Computer Science  
Date: Apr 2017
14. Wesley Hough  
Role: outside examiner  
Title: On Independence, Matching, and Homomorphism Complexes  
Degree: Ph.D., Computer Science  
Date: May 2017

15. Qingguo Xu Degree: M.S., Computer Science  
 Role: member Date: May 2017  
 Title: 3D Body Tracking using Deep Learning
16. Xiaofei Zhang Degree: M.S., Computer Science  
 Role: member Date: Jul 2017  
 Title: Mammogram and Tomosynthesis Classification Using Convolutional Neural Networks
17. Yajie Zhao Degree: Ph.D., Computer Science  
 Role: member Date: Dec 2017  
 Title: 3D Human Face Reconstruction and 2D Appearance Synthesis
18. Po-Chang Su Degree: Ph.D., Electrical Engineering  
 Role: member Date: Dec 2017  
 Title: Real-time Capture and Rendering of Physical Scene with an Efficiently Calibrated RGB-D Camera Network
19. Anthony Rios Degree: Ph.D., Computer Science  
 Role: member Date: Jun 2018  
 Title: Deep Neural Networks for Multi-Label Text Classification: Application to Coding Electronic Medical Records
20. Ethan Welty (University of Colorado–Boulder) Degree: Ph.D., Environmental Studies  
 Role: member Date: Jul 2018  
 Title: High-Precision Photogrammetry for Glaciology
21. Yannick Hold-Geoffroy (Laval University, Quebec, CA) Degree: Ph.D., Computer Science  
 Role: member Date: Aug 2018  
 Title: Learning Geometric and Lighting priors from Natural Images
22. Nkiruka Uzuegbunam Degree: Ph.D., Electrical Engineering  
 Role: member Date: Oct 2018  
 Title: Self-Image Multimedia Technologies for Feedforward Observational Learning
23. Nam Vo (Georgia Institute of Technology) Degree: Ph.D., Computer Science  
 Role: member Date: May 2019  
 Title: Image Geolocalization with Deep Learning
24. Jinping Zhuge Degree: Ph.D., Math  
 Role: outside examiner Date: May 2019  
 Title: Boundary layers in periodic homogenization
25. Ryan Zembrodt Degree: M.S., Computer Science  
 Role: member Date: May 2019  
 Title: Open-World Story Generation with Sequence-to-Sequence and Hierarchical Recurrent Encoder-Decoder Models
26. Jonathan Dingess Degree: M.S., Computer Science  
 Role: member Date: May 2019  
 Title: Epsilon-Superposition and Truncation Dimension in Average and Probabilistic Settings for Infinite-Variate Linear Problems
27. Genghis Goodman Degree: M.S., Computer Science  
 Role: member Date: Jul 2019  
 Title: A Machine Learning Approach to Artificial Floorplan Generation

28. Xinxin Zuo Degree: Ph.D., Computer Science  
 Role: member Date: Oct 2019  
 Title: Depth Enhancement and Surface Reconstruction with RGB-D sequence
29. Sifei Han Degree: Ph.D., Computer Science  
 Role: member Date: Dec 2019  
 Title: Text Mining Methods for Analyzing Online Health Information and Communication
30. Shivangi Srivastava (Wageningen University, Netherlands) Degree: Ph.D., Computer Science  
 Role: member Date: Feb 2020  
 Title: Mapping of urban landuse and landcover with multiple sensors: joining close and remote sensing with deep learning
31. Raian Maretto (National Institute for Space Research) Degree: Ph.D., Geoinformation Science  
 Role: member Date: Feb 2020  
 Title: Deep Learning techniques applied to classification of Remote Sensing Images
32. Kyle Helfrich Degree: Ph.D., Math  
 Role: member Date: Apr 2020  
 Title: Orthogonal Recurrent Neural Networks and Batch Normalization in Deep Neural Networks
33. Subash Khanal Degree: M.S., Electrical Engineering  
 Role: member Date: May 2020  
 Title: Mispronunciation Detection and Diagnosis in Mandarin Accented English Speech
34. Narjes Bozorg Degree: Ph.D., Electrical Engineering  
 Role: member Date: Nov 2020  
 Title: Articulatory-Wavenet: Deep Autoregressive Model for Acoustic-to-Articulatory Inversion
35. Céline Portenier (University of Bern) Degree: Ph.D., Computer Science  
 Role: external referee Date: May 2021  
 Title: High-resolution snow cover retrieval using public webcams
36. Ahmed Nassar (IRISA, Université Bretagne Sud, Vannes) Degree: Ph.D., Computer Science  
 Role: external referee Date: May 2021  
 Title: Learning to map street-side objects using multiple views
37. Alireza Shirvani Degree: Ph.D., Computer Science  
 Role: member Date: Aug 2021  
 Title: Personality and Emotion for Virtual Characters in Strong-story Narrative Planning
38. Sajad Javadinasab Hormozabad Degree: Ph.D., Civil Engineering  
 Role: member Date: Nov 2021  
 Title: Artificial Intelligence and Soft Computing in Smart Structural Systems
39. Chengxi Li Degree: Ph.D., Computer Science  
 Role: member Date: Mar 2022  
 Title: Supporting Stylized Language Models using Multi-Modality Features
40. Tarannum Shaila Zaman Degree: Ph.D., Computer Science  
 Role: member Date: Apr 2022  
 Title: An Automated Framework to Debug System-Level Concurrency Failures
41. David Adeniji Degree: Ph.D., Mechanical Engineering  
 Role: member Date: Apr 2022  
 Title: Establishing a Digital Process Twin for Aerospace Alloy Machining using In-situ Process Characterization and Physics Embedded Machine Learning Models

42. Eike Jens Hoffmann (Technical University of Munich)      Degree: Ph.D., Data Science in Earth Observation  
 Role: reviewer      Date: Oct 2022  
 Title: Predicting Building Functions on Large Scale by Fusing Social Media and Remote Sensing Data
43. Arnab Sarkar      Degree: Ph.D., Physics  
 Role: member      Date: Aug 2022  
 Title: Understanding the Physics of Galaxy Clusters Out to their Virial Radii and Beyond
44. Yuan Liu      Degree: M.S., Computer Science  
 Role: member      Date: Dec 2022  
 Title: Skeleton-Based Analysis of Melt Networks
45. Md Sultan Al Nahian      Degree: Ph.D., Computer Science  
 Role: member      Date: in progress  
 Title: Value Aligned AI Agent with Explainability
46. Sidrah Liaqat      Degree: Ph.D., Electrical Engineering  
 Role: member      Date: in progress  
 Title: Model-based Deep Learning Techniques for Detecting Behaviors Related to Autism Spectrum Disorder from Video
47. Stephen Parsons      Degree: Ph.D., Computer Science  
 Role: member      Date: in progress  
 Title: TBD
48. Minoo Hosseinzadeh      Degree: Ph.D., Computer Science  
 Role: member      Date: in progress  
 Title: TBD
49. Ashutosh Timilsina      Degree: Ph.D., Computer Science  
 Role: member      Date: in progress  
 Title: TBD
50. Sheng-Chieh Lin      Degree: Ph.D., Physics  
 Role: member      Date: in progress  
 Title: TBD
51. Seth Parker      Degree: Ph.D., Computer Science  
 Role: member      Date: in progress  
 Title: TBD
52. Aiden McIlraith      Degree: M.S., Computer Science  
 Role: member      Date: in progress  
 Title: Spatial Transcriptome Visualizer
53. Gustavo Gratacós      Degree: Ph.D., Computer Science  
 Role: member      Date: in progress  
 Title: TBD
54. Zihao Zou      Degree: M.S., Computer Science  
 Role: member      Date: in progress  
 Title: Deep Model-Based Architectures using Explicit Regularizers for Computational Imaging
55. Nan Huang      Degree: M.S., Computer Science  
 Role: member      Date: in progress  
 Title: Toward Continuous Regularizer for Imaging Inverse Problems

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|---|--------------------------------|
| 56. Zhou Chu  | Degree: M.S., Computer Science |
| Role: member  | Date: TBD                      |
| Title: Adapting at time series machine learning models to a real informatics pipe             |                                |
| 57. Pan Xiao  | Degree: Ph.D., Imaging Science |
| Role: member  | Date: TBD                      |
| Title: Text and Image Representation Learning for Radiology Image Analysis                    |                                |
| 58. Yihang Xu   | Degree: M.S., Computer Science |
| Role: member  | Date: TBD                      |
| Title: TBD  |                                |
| 59. Peizhen Tong  | Degree: M.S., Computer Science |
| Role: member  | Date: in progress              |
| Title: Adversarial Patch Attacks on Deep Reinforcement Learning                               |                                |
| 60. David Sarpong   | Degree: M.S., Computer Science |
| Role: member  | Date: in progress              |
| Title: Adversarial Defenses against Interpolation Attacks on Semi-Supervised Learning Systems |                                |

## Oral Qualifying Exam Committees

Student	Date	Advisor
Junlin Wu	Dec 2022	Eugene Vorobeychik
Yiwen Ju	Apr 2023	Tao Ju
Yuanhaur Chang	TBD	Ning Zhang
Han Liu	TBD	Ning Zhang
Jiarui Feng	TBD	Yixin Chen