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Contact Information

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Academic Qualification

- Ph.D. in Computer Software and Theory, Sun Yat-sen University

Teaching Area

- Computer Language and Programming
- Fundamentals of advanced engineering mathematics
- Numerical analysis

Research Area

- Intelligent Information Processing
- Artificial Intelligence
- Computer Graphics and Image Processing
- Multimedia Information Security
- Remote Sensing Data Processing and Analysis
- Applied Mathematics and Scientific Computing

Working Experience

- 2008 - Present., Assistant Professor, Associate Professor, Professor Macau University of Science and Technology, Macau, China
- 2007 - 2008, Visiting Scholar, University of Nevada, Las Vegas, USA

Academic Publication (selected)

1. J. Li, **Z.C. Cai**, M. Zhu, A Spherical Geometric B-Spline Model for Lunar Brightness Temperature Data Approximation, *IEEE Transactions on Geoscience and Remote Sensing*, 63: 1–12 (2025)
2. J. Chen, L. Yang, W. Yu, W. Gong, **Z. Cai** and J. Ma, "SDSFusion: A Semantic-Aware Infrared and Visible Image Fusion Network for Degraded Scenes," *IEEE Transactions on Image Processing*, 34: 3139-3153, 2025
3. J.P. Lan, **Z.C.Cai**, X.J Dong WebGL, XAI and UAV Based Integrated Approach for Waste Management in Smart Cities, *IEEE Transactions on Consumer Electronics*, DOI: 10.1109/TCE.2025.3572069
4. Y. Zhang, J. Yuan, **Z.C. Cai**, DCGF: Diffusion-Color-Guided Framework for Underwater Image Enhancement, *IEEE Transactions on Geoscience and Remote Sensing*, 63: 1–12 (2025)
5. M. Zhu, **Z.C. Cai**, J. Li, A Heat Transfer-Based Framework for Constructing Spatiotemporal Continuous Distribution of Lunar Microwave Emission, *IEEE Transactions on Geoscience and Remote Sensing*, 63: 1–11 (2025)
6. J.H Qin, Y. Ma, J. Huang, **Z.C. Cai**, F. Fan, Y. Du An End-to-End Network for Rotary Motion Deblurring in the Polar Coordinate System. *IEEE Transactions on Circuits and Systems for Video*

- Technology 35(3): 2422-2435 (2025)
7. M. Zhu, **Z.C. Cai**, S. Wu, Y. Zhang, J. Li, High-Resolution Lunar Brightness Temperature Model Based on Chang'e-2 MRM Data and Spatially Weighted Neural Network, *IEEE Transactions on Geoscience and Remote Sensing*, 63: 1–13 (2025)
 8. Y. Zhang, **Z.C. Cai**, DNP-AUT: Image Compression Using Double-Layer Non-Uniform Partition and Adaptive U Transform, *IEEE Transactions on Multimedia*, 27: 249–262 (2025)
 9. J. Li, **Z.C. Cai**, A Hierarchical Spherical Algorithm over the Triangular Domain for Lunar Regional Brightness Temperature Analysis, *IEEE Transactions on Geoscience and Remote Sensing*, 62: 1–11 (2024)
 10. J. Li, **Z.C. Cai**, M. Zhu, A Novel Triangulated Spherical Brightness Temperature Model of the Moon with Chang'e-2 Microwave Radiometer Data, *IEEE Transactions on Geoscience and Remote Sensing*, 62: 1–13 (2024)
 11. F.L. Sun, **Z.C. Cai**, A Family of Generalized Cardinal Polishing Splines, *IEEE Transactions on Image Processing*, 33: 1952-1964 (2024)
 12. F.L. Sun, **Z.C. Cai**, Cubic Polishing Spline-Based Algorithms for Industrial Image Processing, *IEEE Transactions on Industrial Informatics*, 20(1): 314-326 (2024)
 13. Y.Y. Chen, J.Y. Yuan, **Z.C. Cai**, ACCE: An Adaptive Color Compensation and Enhancement Algorithm for Underwater Image, *IEEE Transactions on Geoscience and Remote Sensing*, 62: 1-13 (2024)
 14. Y. Guo, H. Wu, S.J. Yang, **Z.C. Cai**, Crater-DETR: A Novel Transformer Network for Crater Detection Based on Dense Supervision and Multiscale Fusion, *IEEE Transactions on Geoscience and Remote Sensing*, 62: 1-12 (2024)
 15. J.Y. Yuan, **Z.C. Cai**, S.Y. Wang, X.X. Kong, A Multitype Feature Perception and Refined Network for Spaceborne Infrared Ship Detection, *IEEE Transactions on Geoscience and Remote Sensing*, 62: 1-11 (2024)
 16. P.L. Lyu, J.Z. Liu, Y.H. Zhang, Y. Ben, T. Lan, L.P. Bai, **Z.C. Cai**, Z.H. Jiang, A Novel Feature Fusion Framework for Industrial Automation Single-Multiple Object Detection, *IEEE Transactions on Industrial Informatics*, 20(5): 7686-7697 (2024)
 17. Y.H. Wang, B. Ye, **Z.C. Cai**, Dynamic Template Updating Using Spatial-temporal Information in Siamese Trackers, *IEEE Transactions on Multimedia*, 26: 2006-2015 (2024)
 18. S.J. Yang, **Z.C. Cai**, Cross Domain Lifelong Learning Based on Task Similarity, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 45(10): 11612-11623 (2023)
 19. R.Z. Chen, **Z.C. Cai**, UIESC: An Underwater Image Enhancement Framework via Self-attention and Contrastive Learning, *IEEE Transactions on Industrial Informatics*, 19(12): 11701-11711 (2023)
 20. Y.L. Zhang, **Z.C. Cai**, CE-RetinaNet: A Channel Enhancement Method for Infrared Wildlife Detection in UAV Images, *IEEE Transactions on Geoscience and Remote Sensing*, 61(99):1-12(2023)
 21. S.Y. Wang, **Z.C. Cai**, J.Y. Yuan, Automatic SAR Ship Detection Based on Multifeature Fusion Network in Spatial and Frequency Domains, *IEEE Transactions on Geoscience and Remote Sensing*, 61: 1-11 (2023)
 22. H.Q. Huang, **Z.C. Cai**, Duple Color Image Encryption System Based on 3-D Nonequilateral Arnold Transform for IIoT, *IEEE Transactions on Industrial Informatics*, 19(7): 8285-8294 (2023)
 23. R.Z. Chen, **Z.C. Cai**, W. Cao, MFFN: An Underwater Sensing Scene Image Enhancement Method Based on Multiscale Feature Fusion Network, *IEEE Transactions on Geoscience and Remote Sensing*, 60: 1-12 (2022)
 24. S.J. Yang, **Z.C. Cai**, High-Resolution Feature Pyramid Network for Automatic Crater Detection on Mars, *IEEE Transactions on Geoscience and Remote Sensing*, 60: 1-12 (2022)
 25. S.J. Yang, **Z.C. Cai**, Progressive Domain Adaptive Network for Crater Detection, *IEEE Transactions on Geoscience and Remote Sensing*, 60: 1-12 (2022)
 26. B. Ye, **Z.C. Cai**, T. Lan, W. Cao, Modeling of Crater Group Representation Based on V-System, *IEEE Transactions on Geoscience and Remote Sensing*, 60: 1-12 (2022)
 27. J.Y. Yuan, **Z.C. Cai**, W. Cao, TEBCF: Real-World Underwater Image Texture Enhancement Model

- Based on Blurriness and Color Fusion, IEEE Transactions on Geoscience and Remote Sensing, 60: 1-15 (2022)
28. X.X. Yuan, **Z.C. Cai**, ICHV: A New Compression Approach for Industrial Images, IEEE Transactions on Industrial Informatics, 18(7): 4427-4435 (2022)
 29. Y.M. Zhang, **Z.C. Cai**, B. Ye, An Image Importance Partition-Based Compression Method for COVID-19 Computed Tomography Scan, IEEE Transactions on Industrial Informatics, 18(7): 4596-4607 (2022)
 30. T. Lan, **Z.C. Cai**, B. Ye, A Novel Spline Algorithm Applied to COVID-19 Computed Tomography Image Reconstruction, IEEE Transactions on Industrial Informatics, 18(11): 7804-7813 (2022)
 31. X.X. Kong, **Z.C. Cai**, An Information Security Method Based on Optimized High-Fidelity Reversible Data Hiding, IEEE Transactions on Industrial Informatics, 18(12): 8529-8539 (2022)
 32. T. Lan, **Z.C. Cai**, B. Ye, Modeling of Lunar Digital Terrain Entropy and Terrain Entropy Distribution Model, IEEE Transactions on Geoscience and Remote Sensing, 59(2): 1052-1066 (2021)
 33. J.Y. Yuan, W. Cao, **Z.C. Cai**, B.H. Su, An Underwater Image Vision Enhancement Algorithm Based on Contour Bougie Morphology, IEEE Transactions on Geoscience and Remote Sensing, 59(10): 8117-8128 (2021)
 34. T. Lan, **Z.C. Cai**, Efficient Reconstruction of Industrial Images Using Optimized HMK Splines, IEEE Transactions on Industrial Informatics, 17(7): 4657-4668 (2021)
 35. B. Ye, X.X. Yuan, **Z.C. Cai**, T. Lan, Severity Assessment of COVID-19 Based on Feature Extraction and V-Descriptors, IEEE Transactions on Industrial Informatics, 17(11): 7456-7467 (2021)
 36. W.G. He, **Z.C. Cai**, Reversible Data Hiding Based on Dual Pairwise Prediction-Error Expansion, IEEE Transactions on Image Processing, 30:5045-5055(2021).
 37. W.G. He, **Z.C. Cai**, and Y.M. Wang, High-fidelity Reversible Image Watermarking Based on Effective Prediction Error-Pairs Modification, IEEE Transactions on Multimedia, 23: 52-63 (2021)
 38. Y.M. Zhang, **Z.C. Cai**, and G.Q.Xiong, A New Image Compression Algorithm Based on Non-uniform Partition and U-System, IEEE Transactions on Multimedia, 23: 1069-1082 (2021)
 39. T. Lan, **Z.C. Cai**, A Novel Image Representation Method Under a Non-Standard Positional Numeral System, IEEE Transactions on Multimedia, 23: 1301-1315 (2021)
 40. Y.M. Wang, **Z.C. Cai**, W.G. He, High-Capacity Reversible Data Hiding in Encrypted Image Based on Intra-block Lossless Compression, IEEE Transactions on Multimedia, 23: 1466-1473 (2021)
 41. Y.Q. Xiao, **Z.C. Cai**, X.X. Yuan, YuvConv: Multi-Scale Non-Uniform Convolution Structure Based on YUV Color Model, IEEE Transactions on Multimedia, 23: 2533-2544 (2021)
 42. Q.Y. Huang, **Z.C. Cai**, T. Lan, A New Approach for Character Recognition of Multi-Style Vehicle License Plates, IEEE Transactions on Multimedia, 23: 3768-3777 (2021)
 43. X.X. Yuan, **Z.C. Cai**, A Generalized Walsh System and Its Fast Algorithm, IEEE Transactions on Signal Processing, 69: 5222-5233 (2021)
 44. W.G. He, **Z.C. Cai**, An Insight Into Pixel Value Ordering Prediction-Based Prediction-Error Expansion, IEEE Transactions on Information Forensics and Security, 15:3859-3871(2020)
 45. J.J. Chen, **Z. C. Cai**, A New Class of Explicit Interpolatory Splines and Related Measurement Estimation, IEEE Transactions on Signal Processing, 68:2799-2813(2020)
 46. X.X. Yuan, **Z.C. Cai**, An Adaptive Triangular Partition Algorithm for Digital Images, IEEE Transactions on Multimedia, 21(6): 1372-1383(2019)
 47. W. Cao, **Z.C. Cai**, B. Ye, Measuring Multiresolution Surface Roughness Using V-System, IEEE Transactions on Geoscience and Remote Sensing, 56(3): 1497-1506 (2018)
 48. T. Lan, **Z.C. Cai**, Lunar Brightness Temperature Map and TB Distribution Model, IEEE Transactions on Geoscience and Remote Sensing, 56(12): 7310-7323 (2018)
 49. **Z.C. Cai**, T. Lan, Lunar Brightness Temperature Model Based on the Microwave Radiometer Data of Chang'e-2, IEEE Transactions on Geoscience and Remote Sensing, 55(10): 5944-5955(2017)
 50. **Z.C. Cai**, T. Lan, C.M. Zheng, Hierarchical MK Splines: Algorithm and Applications to Data Fitting, IEEE Transactions on Multimedia, 19(5): 921-934(2017)

Books

- Z.C. Cai, Fundamentals of Engineering Mathematics, Science Press, 2018, ISBN-13: 978-7030568632. (in Chinese)
- J. Huang, Z.C. Cai, K.Y. U, Y.Y. Liang, Local Interpolation Explicit Algorithm and Its Application, Science Press, 2016, ISBN-13: 978-7030462947. (in Chinese)

Patents (selected)

- Z.C. Cai and T. Lan, Methods and Apparatus for Encrypting Multimedia Information, US patent, Grant No. 10635786 B2, April 2020.
- Z.C. Cai and W. Cao, Method for Improving Calculations of Surface Roughness, US patent, Grant No. 10580150 B2, March 2020.
- Z.C. Cai and T. Lan, Methods and Apparatus for Image Construction, US patent, Grant No. 10332279 B2, June 2019.
- Z.C. Cai, Methods and Apparatus for Color Image Watermarking, US patent, Grant No. 10296999 B2, May 2019.
- Z.C. Cai and W. Cao, Omnidirectional Roughness Algorithm for Topographic Signature Analysis of Lunar Craters, US patent, Grant No. 10354398 B2, July 2019.
- Z.C. Cai, Lunar Brightness Temperature Modeling Based on the Microwave Radiometer Data, US patent, Grant No. 10346565 B2, July 2019.
- Z.C. Cai, Computer System that Executes Hierarchical MK Splines Scheme for Scattered Data Interpolation, US patent, Grant No. 9990334 B2, June 2018.
- Z.C. Cai, B. Ye, T. Lan, and Y.Q. Xiao, Systems and Methods for Reducing Computer Resources Consumption to Reconstruct Shape of Multi-Object Image, US patent, Grant No. 10062187 B1, August 2018.
- Z.C. Cai and Z. Li, Image Stitching, US patent, Grant No. 9990753 B1, June 2018.
- Z.C. Cai, Color Image Watermarking, US patent, Grant No. 10037587 B2, July 2018.
- Z.C. Cai and T. Lan, Method for Coding Data, US patent, Grant No. 9755661 B1, September 2017.

Professional Certification and Awards

- Second Prize of 2022 National Teaching Achievement Award, 2023.
- Advanced Individual Award, 20th National Post-Graduate Mathematical Contest in Modeling, 2023
- Excellent Supervisor of Contemporary Undergraduate Mathematical Contest in Modeling, CSIAM, 2022.
- 2020/2021 BOC Excellent Research Award, Macau University of Science and Technology, 2021.
- Second Prize of the Teaching Achievement Award (Co-awarded), Macau University of Science and Technology, 2020.
- Third Prize of Technological Invention Award of the Macau Science and Technology Awards (Co-awarded), 2018.
- Excellent Supervisor of Contemporary Undergraduate Mathematical Contest in Modeling, CSIAM, 2017.
- BOC Excellent Research Award, Macau University of Science and Technology, 2016.
- Third Prize of Natural Science Award of the Macau Science and Technology Awards (Co-awarded), 2012.
- Excellent Organization Worker of Contemporary Undergraduate Mathematical Contest in Modeling, CSIAM, 2011.

Student Awards

- Postgraduate Award of the Macau Science and Technology Award, 2022
- Postgraduate Award of the Macau Science and Technology Award, 2016
- First Prize, “HUAWEI Cup” 21st National Post-Graduate Mathematical Contest in Modeling, 2024
- First Prize, “HUAWEI Cup” 20th National Post-Graduate Mathematical Contest in Modeling, 2023
- First Prize, “HUAWEI Cup” 18th National Post-Graduate Mathematical Contest in Modeling, 2021
- First Prize, “HUAWEI Cup” 17th National Post-Graduate Mathematical Contest in Modeling, 2020
- Second Prize, “HUAWEI Cup” 16th National Post-Graduate Mathematical Contest in Modeling, 2019
- Second Prize, “HUAWEI Cup” 15th National Post-Graduate Mathematical Contest in Modeling, 2018
- First Prize, “HUAWEI Cup” 14th National Post-Graduate Mathematical Contest in Modeling, 2017
- Second Prize, “HUAWEI Cup” 13th National Post-Graduate Mathematical Contest in Modeling, 2016
- Third Prize, “Zhongguancun Youth Cup” 12th National Post-Graduate Mathematical Contest in Modeling, 2015
- Second Prize, “HUAWEI Cup” 11th National Post-Graduate Mathematical Contest in Modeling, 2014
- Second Prize, “HUAWEI Cup” 10th National Post-Graduate Mathematical Contest in Modeling, 2013
- Second Prize, “HUAWEI Cup” 10th National Post-Graduate Mathematical Contest in Modeling, 2011
- Second Prize, CUMCM-2024
- Second Prize, CUMCM-2023
- Second Prize, CUMCM-2022
- Second Prize, CUMCM-2021
- Second Prize, CUMCM-2020
- Second Prize, CUMCM-2019
- Second Prize, CUMCM-2018
- Second Prize, CUMCM-2017
- Second Prize, CUMCM-2016
- Second Prize, CUMCM-2014
- First Prize, CUMCM-2003
- Silver Prize, China Pan-Pearl River Delta Region University IT Project Competition 2010
- Gold Prize, China Pan-Pearl River Delta Region University IT Project Competition 2009

Professional Society Membership

- Senior Member, Institute of Electrical and Electronics Engineers (IEEE).
- Distinguished Member, China Computer Federation (CCF).
- Member, Association for Computing Machinery (ACM).
- Member, Asia Graphics Association (AG).
- Committee Member, Computer-Aided Design & Computer Graphics (TCCADCG), CCF
- Committee Member, Geometric Design and Computing of China, CSIAM