

CURRICULUM VITAE OF BIN DONG

EDUCATION

- Ph.D in Mathematics
University of California, Los Angeles, 2005–2009.
- M.Sc. in Mathematics
National University of Singapore, 2003–2005.
- B.S. in Mathematics
Peking University, 1999–2003.

POSITIONS

- Professor, Beijing International Center for Mathematical Research, Peking University, 2023 - present.
- Deputy Director, Center for Machine Learning Research, Peking University, 2022 - present.
- Director, Center for Theory of Artificial Intelligence, Institute for Artificial Intelligence, Peking University, 2019 - 2022.
- Associate Professor (Tenured), Beijing International Center for Mathematical Research, Peking University, 2018 - 2022.
- Associate Professor (w/o Tenure), Beijing International Center for Mathematical Research, Peking University, 2014 - 2018.
- Assistant Professor, Department of Mathematics, The University of Arizona 2011 - 2014.
- SEW Assistant Professor, Department of Mathematics, UCSD 2009 - 2011.

RESEARCH INTERESTS

- Computational imaging
- Scientific computing
- Machine learning

HONORS AND AWARDS

- New Cornerstone Investigator, The New Cornerstone Investigator Program, 2023.
- Invited Sectional Lecture, The International Congress of Mathematicians, 2022.
- Qiu Shi Outstanding Young Scholar Award, Qiu Shi Foundation, Hong Kong, China, 2014.

PUBLICATIONS

Preprint

1. Zhanhong Ye, Xiang Huang, Leheng Chen, Hongsheng Liu, Zidong Wang, Bin Dong, *PDE-former: Towards a Foundation Model for One-Dimensional Partial Differential Equations*, arXiv:2402.12652.
2. Bin Dong, Ting Lin, Zuowei Shen, Peichu Xie, *Analysis of a wavelet frame based two-scale model for enhanced edges*, arXiv:2401.02688.
3. Xinyu Xiao, Zhennan Zhou, Bin Dong, Dingjiong Ma, Li Zhou, Jie Sun, *Meta-DSP: A Meta-Learning Approach for Data-Driven Nonlinear Compensation in High-Speed Optical Fiber Systems*, arXiv:2311.10416.
4. Mingze Yuan, Peng Bao, Jiajia Yuan, Yunhao Shen, Zifan Chen, Yi Xie, Jie Zhao, Yang Chen, Li Zhang, Lin Shen, Bin Dong, *Large Language Models Illuminate a Progressive Pathway to Artificial Healthcare Assistant: A Review*, arXiv:2311.01918.
5. Zhuoyuan Li, Bin Dong, Pingwen Zhang, *Latent assimilation with implicit neural representations for unknown dynamics*, arXiv:2309.09574.
6. Bin Dong, Xuhua He, Pengfei Jin, Felix Schremmer, Qingchao Yu, *Machine learning assisted exploration for affine Deligne-Lusztig varieties*, arXiv:2308.11355.

7. Zhanhong Ye, Hongsheng Liu, Zidong Wang, Bin Dong, *Analysis of the Decoder Width for Parametric Partial Differential Equations*, arXiv:2306.14390.
8. Zifan Chen, Jiazheng Li, Jie Zhao, Yiting Liu, Hongfeng Li, Bin Dong, Lei Tang and Li Zhang, *PropNet: Propagating 2D Annotation to 3D Segmentation for Gastric Tumors on CT Scans*, arXiv:2305.17871.
9. Peng Bao, Gong Wang, Ruijie Yang, Bin Dong, *Deep Reinforcement Learning for Beam Angle Optimization of Intensity-Modulated Radiation Therapy*, arXiv:2303.03812.
10. Haocheng Ju, Haimiao Zhang, Lin Li, Xiao Li, Bin Dong, *A Comparative Study of Deep Learning and Iterative Algorithms for Joint Channel Estimation and Signal Detection*, arXiv:2303.03678.
11. Pu Yang and Bin Dong, *L2SR: Learning to Sample and Reconstruct for Accelerated MRI*, arXiv:2212.02190.

Journal Articles

1. Yifan Luo, Yiming Tang, Chengfeng Shen, Zhennan Zhou, Bin Dong, *Prompt engineering through the lens of optimal control*, accepted by Journal of Machine Learning (arXiv:2310.14201), 2023.
2. Zhengyi Li, Yanli Wang, Hongsheng Liu, Zidong Wang, Bin Dong, *Solving Boltzmann equation with neural sparse representation*, accepted by SIAM Journal on Scientific Computing (arXiv:2302.09233).
3. Jiajia Yuan, Peng Bao, Zifan Chen, Mingze Yuan, Jie Zhao, Jiahua Pan, Yi Xie, Yanshuo Cao, Yakun Wang, Zhenghang Wang, Zhihao Lu, Xiaotian Zhang, Jian Li, Lei Ma, Yang Chen, Li Zhang, Lin Shen and Bin Dong, *Advanced Prompting as a Catalyst: Empowering Large Language Models in the Management of Gastrointestinal Cancers*, The Innovation Medicine, 1(2), 100019, 2023.
4. Zhanhong Ye, Xiang Huang, Hongsheng Liu, Bin Dong, *Meta-Auto-Decoder: A Meta-Learning Based Reduced Order Model for Solving Parametric Partial Differential Equations*, Communications on Applied Mathematics and Computation, doi.org/10.1007/s42967-023-00293-7, 2023 (arXiv:2302.08263).
5. Wei Wan, Yuejin Zhang, Chenglong Bao, Bin Dong, Zuoqiang Shi, *A scalable deep learning approach for solving high-dimensional dynamic optimal transport*, SIAM Journal on Scientific Computing, **45(4)**, B644–B563, 2023 (arXiv:2205.07521).
6. Zhiwen Deng, Jing Wang, Hongsheng Liu, Hairun Xie, BoKai Li, Miao Zhang, Tingmeng Jia, Yi Zhang, Zidong Wang, Bin Dong, *Prediction of transonic flow over supercritical airfoils using geometric-encoding and deep-learning strategies*, Physics of Fluids, DOI: 10.1063/5.0155383, 2023 (arXiv:2303.03695).
7. Meng He, Zi-Fan Chen, Li Zhang, Xiangyu Gao, Xiaoyi Chong, Hao-shen Li, Lin Shen, Jiafu Ji, Xiaotian Zhang, Bin Dong, Zi-Yu Li and Tang Lei, *Associations of subcutaneous fat area and Systemic Immune-inflammation Index with survival in patients with advanced gastric cancer receiving dual PD-1 and HER2 blockade*, Journal of ImmunoTherapy of Cancer, 11:e007054, 2023.
8. Chaoyan Huang, Tingting Wu, Juncheng Li, Bin Dong, Tiejong Zeng, *Single-Particle Reconstruction in Cryo-EM based on Three-dimensional Weighted Nuclear Norm Minimization*, Pattern Recognition, doi.org/10.1016/j.patcog.2023.109736, 2023.
9. Jiazheng Li, Zifan Chen, Yang Chen, Jie Zhao, Meng He, Xiaoting Li, Li Zhang, Bin Dong, Xiaotian Zhang, Lei Tang, Lin Shen, *CT-based delta radiomics in predicting the prognosis of stage IV gastric cancer to immune checkpoint inhibitors*, Frontiers in Oncology, DOI: 10.3389/fonc.2022.1059874, 2023.

10. Zhengyi Li, Bin Dong and Yanli Wang, *Learning Invariance Preserving Moment Closure Model for Boltzmann-BGK Equation*, Communications in Mathematics and Statistics, **11(1)**, 59–101, 2023 (arXiv:2110.03682).
11. Yang Chen, Keren Jia, Yu Sun, Cheng Zhang, Yilin Li, Li Zhang, Zifan Chen, Jiangdong Zhang, Yajie Hu, Jiajia Yuan, Xingwang Zhao, Yanyan Li, Jifang Gong, Bin Dong, Xiaotian Zhang, Jian Li and Lin Shen, *Predicting response to immunotherapy in gastric cancer via multi-dimensional analyses of the tumour immune microenvironment*, Nature Communications, **13**:4851, 2022.
12. Qilin Zhang, Peng Bao, Ang Qu, Weijuan Jiang, Ping Jiang, Hongqing Zhuang, Bin Dong, Ruijie Yang, *The feasibility study on the generalization of deep learning dose prediction model for volumetric modulated arc therapy of cervical cancer*, Journal of Applied Clinical Medical Physics, **23(6)**, e13583, 2022.
13. Chenglong Bao, Jian-Feng Cai, Jae Kyu Choi, Bin Dong, and Ke Wei, *Improved Harmonic Incompatibility Removal for Susceptibility Mapping via Reduction of Basis Mismatch*, Journal of Computational Mathematics, **40(6)**, 914-937, 2022.
14. Stefan C. Schonsheck, Bin Dong and Rongjie Lai, *Parallel Transport Convolution: A New Tool for Convolutional Neural Networks on Manifolds*, SIAM Journal on Imaging Science, **15(1)**, pp. 367–386, 2022 (arXiv:1805.07857).
15. Yuyan Chen, Bin Dong, Jinchao Xu, *Meta-MgNet: Meta Multigrid Networks for Solving Parameterized Partial Differential Equations*, Journal of Computational Physics, **455**, 110996, 2022 (arXiv:2010.14088).
16. Jin Zhao, Weifeng Zhao, Zhiting Ma, Wen-An Yong, Bin Dong, *Finding Models of Heat Conduction via Machine Learning*, International Journal of Heat and Mass Transfer, **185**, 122396, 2022.
17. Ziju Shen, Yufei Wang, Dufan Wu, Xu Yang and Bin Dong, *Learning to Scan: A Deep Reinforcement Learning Approach for Personalized Scanning in CT Imaging*, Inverse Problems and Imaging, **16 (1)**, 179, 2022 (arXiv:2006.02420).
18. Pengfei Jin, Tianhao Lai, Rongjie Lai and Bin Dong, *NPTC-net: Narrow-Band Parallel Transport Convolutional Neural Network on Point Clouds*, Journal of Scientific Computing, **90 (39)**, 2021 (arXiv: 1905.12218).
19. Peiting You, Xiang Li, Zhijiang Wang, Huali Wang, Bin Dong and Quanzheng Li, *Characterization of Brain Iron Deposition Pattern and Its Association With Genetic Risk Factor in Alzheimers Disease Using Susceptibility-Weighted Imaging*, Front. Hum. Neurosci., **15**, 654381, 2021.
20. Bin Dong, Zuwei Shen and Jianbin Yang, *Approximation from Noisy Data*, SIAM Journal on Numerical Analysis, **59 (5)**, 2722C-2745, 2021.
21. Ti Bai, Biling Wang, Dan Nguyen, Bao Wang, Bin Dong, Wenxiang Cong, Mannudeep K. Kalra and Steve Jiang, *Deep Interactive Denoiser (DID) for X-Ray Computed Tomography*, IEEE Transactions on Medical Imaging, **40 (11)**, 2965–2975, 2021 (arXiv:2011.14873).
22. Haimiao Zhang, Baodong Liu, Hengyong Yu and Bin Dong, *MetaInv-Net: Meta Inversion Network for Sparse View CT Image Reconstruction*, IEEE Transactions on Medical Imaging, **40 (2)**, 621–634, 2021 (arXiv:2006.00171).
23. Bin Dong, Haochen Ju, Yiping Lu and Zuoqiang Shi, *CURE: Curvature Regularization For Missing Data Recovery*, SIAM Journal on Imaging Science, **13(4)**, 2169–2188, 2020 (arXiv:1901.09548).
24. Chenyang Shen, Dan Nguyen, Zhiguo Zhou, Steve B. Jiang, Bin Dong, and Xun Jia, *An introduction to deep learning in medical physics: advantages, potential, and challenges*, Physics in Medicine and Biology, **65(5)**: 05TR01-, 2020.

25. Haimiao Zhang and Bin Dong, A Review on Deep Learning in Medical Image Reconstruction, *Journal of the Operations Research Society of China*, 8(2):311-340, 2020 (arXiv: 1906.10643).
26. Yufei Wang, Ziju Shen, Zichao Long and Bin Dong, *Learning to Discretize: Solving 1D Scalar Conservation Laws via Deep Reinforcement Learning*, *Communications in Computational Physics*, **28**, 2158–2179, 2020 (arXiv: 1905.11079).
27. Junyu Liu, Xiao Wang, Yan Zhao, Bin Dong, Kuan Lu and Ranran Wang, *Heating load forecasting for combined heat and power plants via strand-based LSTM*, *IEEE Access*, **8**, 33360–33369, 2020.
28. Jae Kyu Choi, Bin Dong and Xiaoqun Zhang, *An edge driven wavelet frame model for image restoration*, *Applied and Computational Harmonic Analysis*, **48(3)**:993-1029, 2020.
29. Zichao Long, Yiping Lu and Bin Dong, *PDE-Net 2.0: Learning PDEs from Data with A Numeric-Symbolic Hybrid Deep Network*, *Journal of Computational Physics*, **399**, 108925, 2019. (arXiv:1812.04426)
30. Bin Dong, *Mathematical and Deep Learning Methods in Image Inverse Problems*, *Mathematica Nuemrica Sinica*, **41(4)**, 2019 (in Chinese).
31. Geng Chen, Bin Dong, Yong Zhang, Weili Lin, Dinggang Shen and Pew-Thian Yap, *XQ-SR: Joint x-q Space Super-Resolution with Application to Infant Diffusion MRI*, *Medical Image Analysis*, doi: <https://doi.org/10.1016/j.media.2019.06.010>, 2019.
32. Geng Chen, Bin Dong, Yong Zhang, Weili Lin, Dinggang Shen and Pew-Thian Yap, *Denoising of Diffusion MRI Data via Graph Framelet Matching in x-q Space*, *IEEE Transactions on Medical Imaging*, DOI: 10.1109/TMI.2019.2915629, 2019.
33. Chenglong Bao, Jae Kyu Choi and Bin Dong, *Whole Brain Susceptibility Mapping Using Harmonic Incompatibility Removal*, *SIAM Journal on Imaging Science*, 12(1), 492-520, 2019 (arXiv1805.12521).
34. Geng Chen, Jian Zhang, Yong Zhang, Bin Dong, Dinggang Shen and Pew-Thian Yap, *Multi-channel framelet denoising of diffusion weighted images*, *PLoS ONE*, 14(2): e0211621, 2019.
35. Geng Chen, Bin Dong, Yong Zhang, Weili Lin, Dinggang Shen and Pew-Thian Yap, *Angular upsampling in infant diffusion MRI using neighborhood matching in x-q space*, *Front. Neuroinform.* 12:57. doi: 10.3389/fninf.2018.00057.
36. Zenghui Wei, Baodong Liu, Bin Dong and Long Wei, *A joint reconstruction and segmentation method for limited-angle X-ray tomography*, *IEEE Access*, 6(1), 7780–7791, 2018.
37. Haimiao Zhang, Bin Dong and Baodong Liu, *A re-weighted joint spatial-Radon domain CT image reconstruction model for metal artifact reduction*, *SIAM Journal on Imaging Science*, 11(1), 707–733 2018.
38. Yue Selena Niu, Ning Hao and Bin Dong, *A new reduced-rank linear discriminant analysis method and its applications*, *Statistica Sinica*, 28, 189–202, 2018.
39. Bin Dong, Qingtang Jiang and Zuowei Shen, *Image restoration: wavelet frame shrinkage, nonlinear evolution PDEs, and beyond*, *Multiscale Modeling and Simulation: A SIAM Interdisciplinary Journal*, 15(1), 606–660, 2017.
40. Yu Yang, Bin Dong and Zaiwen Wen, *Randomized Algorithms For High Quality Treatment Planning in Volumetric Modulated Arc Therapy*, *Inverse Problems*, 33(2), 025007, 2017.
41. Bin Dong, Zuowei Shen and Peichu Xie, *Image restoration: a general wavelet frame based model and its asymptotic analysis*, *SIAM Journal on Mathematical Analysis*, 49(1), 421C-445, 2017.
42. Bin Dong, *Sparse Representation on Graphs by Tight Wavelet Frames and Applications*, *Applied and Computational Harmonic Analysis*, 42(3), 452C-479, 2017.

43. Jae Kyu Choi, Bin Dong and Xiaoqun Zhang, *Limited Tomography Reconstruction via Tight Frame and Simultaneous Sinogram Extrapolation*, Journal of Computational Mathematics, **34(6)**, 575C-589, 2016.
44. Chenglong Bao, Bin Dong, Likun Hou, Zuwei Shen and Xiaoqun Zhang, Xue Zhang, *Image restoration by minimizing zero norm of wavelet frame coefficients*, Inverse Problems, **32(11)**, 2016.
45. Ruohan Zhan and Bin Dong, *CT Image Reconstruction by Spatial-Radon Domain Data-Driven Tight Frame Regularization*, SIAM Journal on Imaging Sciences, **9(3)**, 1063–1083, 2016.
46. Bin Dong, Qingtang Jiang, Chaoqiang Liu and Zuwei Shen, *Multiscale Representation of Surfaces by Tight Wavelet Frames with Applications to Denoising*, Applied and Computational Harmonic Analysis, **41(2)**, 561–589, 2016.
47. Jian-Feng Cai, Bin Dong and Zuwei Shen, *Image restoration: A wavelet frame based model for piecewise smooth functions and beyond*, Applied and Computational Harmonic Analysis, **41(1)**, 94–138, 2016.
48. Jiulong Liu, Xiaoqun Zhang, Bin Dong, Zuwei Shen and Lixu Gu, *A wavelet frame method with shape prior for ultrasound video segmentation*, SIAM Journal on Imaging Sciences, **9(2)**, 495–536, 2016.
49. Ning Hao, Bin Dong and Jianqing Fan, *Sparsifying the Fisher Linear Discriminant by Rotation*, Journal of the Royal Statistical Society Series B, **77(4)**, 827-851, 2015.
50. Li-Tien Cheng, Bin Dong, Chunhua Men, Xun Jia and Steve B. Jiang, *Binary Level-Set Shape Optimization Model and Algorithm for Volumetric Modulated Arc Therapy in Cancer Radiotherapy*, SIAM Journal on Scientific Computing, **35(6)**, 1321–1340, 2013.
51. Xuejun Gu, Bin Dong, Jing Wang, John Yordy, Loren Mell, Xun Jia, and Steve B. Jiang, *A Contour-Guided Deformable Image Registration Algorithm for Adaptive Radiotherapy*, Physics in Medicine and Biology, **58(6)**, 1889, 2013.
52. Bin Dong and Yong Zhang, *An efficient algorithm for ℓ_0 minimization in wavelet frame based image restoration*, Journal of Scientific Computing, **54(2-3)**, 350–368, 2013.
53. Bin Dong, Jia Li and Zuwei Shen, *X-ray CT image reconstruction via wavelet frame based regularization and Radon domain inpainting*, Journal of Scientific Computing, **54(2-3)**, 333–349, 2013.
54. Yong Zhang, Bin Dong and Zhaosong Lu, *ℓ_0 minimization for wavelet frame based image restoration*, Mathematics of Computation, **82**, 995–1015, 2013.
55. Bin Dong, Yan Jiang Graves, Xun Jia and Steve B. Jiang, *Optimal Surface Marker Locations for Tumor Motion Estimation in Lung Cancer Radiotherapy*, Physics in Medicine and Biology, **57(24)**, 8201, 2012.
56. Jian-Feng Cai, Bin Dong, Stanley Osher and Zuwei Shen, *Image restoration: total variation; wavelet frames; and beyond*, Journal of the American Mathematical Society, **25(4)**, 1033–1089, 2012.
57. Bin Dong, Hui Ji, Jia Li, Zuwei Shen and Yuhong Xu, *Wavelet frame based blind image inpainting*, Applied and Computational Harmonic Analysis, **32(2)**, 268–279, 2012.
58. Bin Dong and Zuwei Shen, *Wavelet frame based surface reconstruction from unorganized points*, Journal of Computational Physics, **230(22)**, 8247–8255, 2011.
59. Xun Jia, Bin Dong, Yifei Lou and Steve B. Jiang, *GPU-based iterative cone beam CT reconstruction using tight frame regularization*, Physics in Medicine and Biology, **56**, 3787–3807, 2011.
60. A. Chien, J. Sayre, B. Dong, J. Ye and F. Vinuela, *3D Quantitative Evaluation of Atherosclerotic Plaque based on Rotational Angiography*, American Journal of Neuroradiology, **32**, 1249–1254, 2011

61. Zhen Tian, Xun Jia, Bin Dong, Yifei Lou and Steve B. Jiang, *Low-dose 4DCT reconstruction via temporal nonlocal means*, Medical Physics, **38 (3)**, March 2011.
62. B. Dong, A. Chien and Z. Shen, *Frame based segmentation for medical images*, Communications in Mathematical Sciences, **9(2)**, 551–559, 2011.
63. Daren Lee, Ivo Dinov, Bin Dong, Boris Gutman, Igor Yanovsky and Arthur W. Toga, *CUDA optimization strategies for compute- and memory-bound neuroimaging algorithms*, Computer Methods and Programs in Biomedicine, Elsevier, 2010.
64. Y. Mao, B. Dong and S. Osher, *A nonlinear PDE-based method for sparse deconvolution*, Multiscale Modeling and Simulation: A SIAM Interdisciplinary Journal, **8(3)**, 965–976, 2010.
65. B. Dong, A. Chien, Z. Shen and S. Osher, *A new multiscale representation for shapes and its application to blood vessel recovery*, SIAM Journal on Scientific Computing, **32(4)**, 1724–1739, 2010.
66. B. Dong, A. Chien, Y. Mao, J. Ye and S. Osher, *Level set based brain aneurysm capturing in 3D*, Inverse Problems and Imaging (special issue in medical image analysis), **4(2)**, 241–255, 2010.
67. B. Dong, N. Dyn and K. Hormann, *Properties of dual pseudo-splines*, Applied and Computational Harmonic Analysis, **29(1)**, 104–110, 2010.
68. S. Osher, Y. Mao, B. Dong and W. Yin, *Fast linearized Bregman iterations for compressive sensing and sparse denoising*, Communications in Mathematical Sciences, Vol. **8(1)**, 93–111, 2010.
69. B. Dong, J. Ye, S. Osher and I. D. Dinov, *Level set based nonlocal surface restoration*, Multiscale Modeling and Simulation: A SIAM Interdisciplinary Journal, **7(2)**, 589–598, 2008.
70. B. Dong and Z. Shen, *Pseudo-splines, wavelets and framelets*, Appl. Comput. Harmon. Anal., **22**, 78–104, 2007.
71. B. Dong and Z. Shen, *Linear independence of pseudo-splines*, Proc. Amer. Math. Soc., **134 (9)**, 2685–2694, 2006.
72. B. Dong and Z. Shen, *Construction of biorthogonal wavelets from pseudo-splines*, J. Approx. Theory, Vol **138 (2)**, 211–231, 2006.

Conference Proceedings

1. Yutong Xie, Mingze Yuan, Bin Dong, Quanzheng Li, *Unsupervised Image Denoising with Score Function*, NeurIPS 2023 (arXiv:2304.08384).
2. Hexin Dong, Jiawen Yao, Yuxing Tang, Mingze Yuan, Yingda Xia, Jian Zhou, Hong Lu, Jingren Zhou, Bin Dong, Le Lu, Li Zhang, Zaiyi Liu, Yu Shi, Ling Zhang, *Improved Prognostic Prediction of Pancreatic Cancer Using Multi-Phase CT by Intergrating Neural Distance and Texture-Aware Transformer*, MICCAI 2023.
3. Mingze Yuan, Yingda Xia, Xin Chen, Jiawen Yao, Junli Wang, Mingyan Qiu, Hexin Dong, Jingren Zhou, Bin Dong, Le Lu, Li Zhang, Zaiyi Liu and Ling Zhang, *Cluster-Induced Mask Transformers for Effective Opportunistic Gastric Cancer Screening on Non-contrast CT Scans*, MICCAI 2023.
4. Mingze Yuan, Yingda Xia, Hexin Dong, Zifan Chen, Jiawen Yao, Mingyan Qiu, Ke Yan, Xiaoli Yin, Yu Shi, Xin Chen, Zaiyi Liu, Bin Dong, Jingren Zhou, Le Lu, Ling Zhang, Li Zhang, *Devil is in the Queries: Advancing Mask Transformers for Real-world Medical Image Segmentation, OOD Detection and Localization*, CVPR 2023.
5. Xiang Huang, Zhanhong Ye, Hongsheng Liu, Bei Shi, Zidong Wang, Kang Yang, Yang Li, Bingya Weng, Min Wang, Haotian Chu, Jing Zhou, Fan Yu, Bei Hua, Lei Chen, Bin Dong, *Meta-Auto-Decoder for Solving Parametric Partial Differential Equations*, NeurIPS 2022, spotlight (arXiv:2111.08823).

6. Hexin Dong, Zifan Chen, Mingze Yuan, Yutong Xie, Jie Zhao, Fei Yu, Bin Dong, Li Zhang, *Region-Aware Metric Learning for Open World Semantic Segmentation via Meta-Channel Aggregation*, IJCAI 2022.
7. Xiang Huang, Hongsheng Liu, Beiji Shi, Zidong Wang, Kang Yang, Yang Li, Bingya Weng, Min Wang, Haotian Chu, Jing Zhou, Fan Yu, Bei Hua, Lei Chen, Bin Dong, *Solving Partial Differential Equations with Point Source Based on Physics-Informed Neural Networks*, IJCAI 2022 (arXiv:2111.01394).
8. Bin Dong, *On Mathematical Modeling in Image Restoration and Beyond*, Proceedings of the International Congress of Mathematicians, International Mathematical Union (Virtual Meeting), 2022.
9. Mo Zhang, Bin Dong, Quanzheng Li, *Joint Attention for Medical Image Segmentation*, ISBI 2022.
10. Mo Zhang, Bin Dong, Quanzheng Li, *MS-GWNN: Multi-Scale Graph Wavelet Neural Network for Breast Cancer Diagnosis*, ISBI 2022.
11. Qi Sun, Hexin Dong, Zewei Chen, Weizhen Dian, Jiacheng Sun, Yitong Sun, Zhenguo Li, Bin Dong, *A Practical Layer-Parallel Training Algorithm for Residual Networks*, NeurIPS 2021 Workshop on Deep Learning and Differential Equations, 2021 (arXiv:2009.01462).
12. Ce Wang, Haimiao Zhang, Qian Li, Kun Shang, Yuanyuan Lyu, Bin Dong, S. Kevin. Zhou, *Generalizable Limited-Angle CT Reconstruction via Sinogram Extrapolation*, MICCAI 2021 (arXiv:2103.05255).
13. Chizhou Liu, Yunzhen Feng, Ranran Wang and Bin Dong, *Enhancing Certified Robustness of Smoothed Classifiers via Weighted Model Ensembling*, ICML 2021 Workshop on Adversarial Machine Learning (arXiv:2005.09363).
14. Haiwen Huang, Zhihan Li, Lulu Wang, Sishuo Chen, Bin Dong, Xinyu Zhou, *Feature Space Singularity for Out-of-Distribution Detection*, AAAI Workshop on SafeAI, 2021 (arXiv:2011.14654).
15. Fei Yu, Mo Zhang, Hexin Dong, Sheng Hu, Bin Dong, Li Zhang, *DAST: Unsupervised Domain Adaptation in Semantic Segmentation Based on Discriminator Attention and Self-Training*, AAAI 2021.
16. Mo Zhang, Bin Dong and Quanzheng Li, *Deep Active Contour Network for Medical Image Segmentation*, MICCAI 2020.
17. Fei Yu, Hexin Dong, Mo Zhang, Jie Zhao, Bin Dong, Quanzheng Li, Li Zhang, *AF-SEG: an Annotation-Free Approach for Image Segmentation by Self-Supervision and Generative Adversarial Network*, IEEE International Symposium on Biomedical Imaging (ISBI20), 2020.
18. Hexin Dong, Fei Yu, Jiang Han, Zhang Hua, Bin Dong, Quanzheng Li, Li Zhang, *Annotation-Free Gliomas Segmentation Based on a Few Labeled General Brain Tumor Images*, IEEE International Symposium on Biomedical Imaging (ISBI20), 2020.
19. Bin Dong, Jikai Hou, Yiping Lu and Zhihua Zhang, *Distillation \approx Early Stopping? Harvesting Dark Knowledge Utilizing Anisotropic Information Retrieval for Overparameterized Neural Network*, NeurIPS 2019 Workshop on Machine Learning with Guarantees, (arXiv:1910.01255).
20. Yiping Lu, Zhuohan Li, Di He, Zhiqing Sun, Bin Dong, Tao Qin, Liwei wang, Tie-Yan Liu, *Understanding and Improving Transformer from a Multi-Particle Dynamic System Point of View*, NeurIPS 2019, Workshop on Machine Learning and the Physical Sciences (arXiv:1906.02762).
21. Dinghuai Zhang, Tianyuan Zhang, Yiping Lu, Zhanxing Zhu, Bin Dong, *You Only Propagate Once: Accelerating Adversarial Training Using Maximal Principle*, NeurIPS 2019 (arXiv:1905.00877).

22. Yini Pan, Hongfeng Li, Lili Liu, Quanzheng Li, Xinlin Hou and Bin Dong, aEEG Signal Analysis with Ensemble Learning for Newborn Seizure Detection, MICCAI Workshop on MMMI, 2019
23. Fei Yu, Jie Zhao, Yanjun Gong, Zhi Wang, Yuxi Li, Fan Yang, Bin Dong, Quanzheng Li and Li Zhang, *Annotation-Free Cardiac Vessel Segmentation via Knowledge Transfer from Retinal Images*, MICCAI 2019.
24. Haiwen Huang, Chang Wang and Bin Dong, *Nostalgic Adam: Weighing more of the past gradients when designing the adaptive learning rate*, IJCAI 2019 (arXiv:1805.07557).
25. Haimiao Zhang, Bin Dong and Baodong Liu, JSR-Net: A Deep Network for Joint Spatial-Radon Domain CT Reconstruction from incomplete data, accepted by the International Conference on Acoustics, Speech, and Signal Processing (IEEE-ICASSP 2019), 2019 (arXiv:1812.00510).
26. Xiaoshuai Zhang, Yiping Lu, Jiaying Liu and Bin Dong, Dynamically Unfolding Recurrent Restorer: A Moving Endpoint Control Method for Image Restoration, ICLR 2019 (arXiv:1805.07709).
27. Dufan Wu, Kyungsang Kim, Bin Dong, Georges El Fakhri and Quanzheng Li, *End-to-End Lung Nodule Detection in Computed Tomography*, MICCAI MLMI Workshop, 2018 (arXiv:1711.02074).
28. Yiping Lu, Aoxiao Zhong, Quanzheng Li and Bin Dong, *Beyond Finite Layer Neural Networks: Bridging Deep Architectures and Numerical Differential Equations*, Thirty-fifth International Conference on Machine Learning (ICML), 2018 (arXiv:1710.10121).
29. Zichao Long, Yiping Lu, Xianzhong Ma and Bin Dong, *PDE-Net: Learning PDEs from Data*, Thirty-fifth International Conference on Machine Learning (ICML), 2018 (arXiv:1710.09668).
30. Geng Chen, Bin Dong, Yong Zhang, Dinggang Shen, Pew-Thian Yap, *q-Space Upsampling Using x - q Space Regularization*, MICCAI 2017, 620–628.
31. Geng Chen, Bin Dong, Yong Zhang, Dinggang Shen, Pew-Thian Yap, *Neighborhood Matching for Curved Domains with Application to Denoising in Diffusion MRI*, MICCAI 2017, 629–637.
32. Pew-Thian Yap, Bin Dong, Yong Zhang and Dinggang Shen, *Tight Graph Framelets for Sparse Diffusion MRI q -Space Representation*, MICCAI 2016, the 19th International Conference on Medical Image Computing and Computer Assisted Intervention, October 17-21, 2016, Athens, Greece.
33. Bin Dong and Ning Hao, *Semi-supervised high dimensional clustering by tight wavelet frames*, Proceedings of SPIE 2015, Wavelets & Sparsity XVI, Aug. 2015.
34. Bin Dong and Zuowei Shen, *Image restoration: a data-driven perspective*, Proceedings of the International Congress of Industrial and Applied Mathematics (ICIAM), Beijing, China, Aug. 10–14, 2015.
35. J. Ye, I. Yanovsky, B. Dong, R. Gandlin, A. Brandt and S. Osher, *Multigrid narrow band surface reconstruction via level set functions*, 8th International Symposium on Visual Computing (ISVC), July 16-18, 2012, Greece.
36. Bin Dong and Zuowei Shen, *MRA-based wavelet frames and applications: image segmentation and surface reconstruction*, Proceedings of SPIE, Defense, Security and Sensing, Vol 8401, 2012.
37. Xun Jia, Yifei Lou, Bin Dong, Zhen Tian and Steve Jiang, *4D computed tomography reconstruction from few-projection data via temporal non-local regularization*, MICCAI 2010: the 13th International Conference on Medical Image Computing and Computer Assisted Intervention, Beijing, China, Sep 20-24, 2010.
38. B. Dong, E. Savitsky and S. Osher, *A novel method for enhanced needle localization using ultrasound-guidance*, Advances in Visual Computing: Part I, 914-923, 2009 (5th International Symposium on Visual Computing, ISVC 2009, Las Vegas, Nevada, USA).

39. B. Dong, Y. Mao, I. D. Dinov, Z. Tu, Y. Shi, Y. Wang and A. W. Toga, *Wavelet-based representation of biological shapes*, Advances in Visual Computing: Part I, 914-923, 2009 (5th International Symposium on Visual Computing, ISVC 2009, Las Vegas, Nevada, USA).
40. B. Dong, A. Chien, Y. Mao, J. Ye and S. Osher, *Level set based surface capturing in 3D medical images*, MICCAI 2008: the 11th International Conference on Medical Image Computing and Computer Assisted Intervention, New York, Sep. 6-10, 2008.

Books & Book Chapters

1. Bin Dong, Zuowei Shen and Xiaoqun Zhang, *Mathematical Methods in Image Restoration*, The Institute Lecture, Chinese Academy of Science, China Science Publishing & Media Ltd (Nanhua Xi eds), 2017 (in Chinese).
2. Gaoyan Ou, Zhanxing Zhu, Bin Dong and Weinan E, *Introduction to Data Science*, High Education Press, 2017 (in Chinese).
3. Bin Dong and Zuowei Shen, *MRA-Based Wavelet Frames and Applications*, IAS Lecture Notes Series, in Zhao, Hong-Kai, ed. "Mathematics in Image Processing". Vol. 19. American Mathematical Society, 2013.

Technical Reports:

1. Yifan Luo and Bin Dong, *Double Descent of Discrepancy: A Task-, Data-, and Model-Agnostic Phenomenon*, arXiv:2305.15907.
2. Yutong Xie, Mingze Yuan, Bin Dong, Quanzheng Li, *Diffusion Model for Generative Image Denoising*, arXiv:2302.02398.
3. Pu Yang and Bin Dong, *L2SR: Learning to Sample and Reconstruct for Accelerated MRI*, arXiv:2212.02190.
4. Bin Dong, *A Note on Machine Learning Approach for Computational Imaging*, arXiv:2202.11883, 2022.
5. Yutong Xie, Dufan Wu, Bin Dong, Quanzheng Li, *Trained Model in Supervised Deep Learning is a Conditional Risk Minimizer*, arXiv:2202.03674.
6. Qi Sun, Hexin Dong, Zewei Chen, Jiacheng Sun, Zhenguo Li, Bin Dong, *Layer-Parallel Training of Residual Networks with Auxiliary-Variable Networks*, arXiv:2112.05387.
7. Hexin Dong, Fei Yu, Jie Zhao, Bin Dong and Li Zhang, *Unsupervised Domain Adaptation in Semantic Segmentation Based on Pixel Alignment and Self-Training*, arXiv:2109.14219. (This is the technical report of the championship of CrossModa 2022 - segmentation task.)
8. Yunzhen Feng, Runtian Zhai, Di He, Liwei Wang and Bin Dong, *Transferred Discrepancy: Quantifying the Difference Between Representations*, arXiv:2007.12446, 2020.
9. Junyu Liu, Zichao Long, Ranran Wang, Jie Sun and Bin Dong, *RODE-Net: Learning Ordinary Differential Equations with Randomness from Data*, arXiv:2006.02377, 2020.
10. Robert Crandall, Bin Dong and Ali Bilgin, *Randomized Iterative Hard Thresholding: A Fast Approximate MMSE Estimator for Sparse Approximations*, Technical Report, June 2013.

JOURNAL
EDITORIAL SERVICE

- Associate editor, Journal of Machine Learning, 2022–.
- Associate editor, Journal of Computational Mathematics, 2021–.
- Associate editor, SIAM Transactions on Applied Mathematics, 2019–.
- Editorial board, Inverse Problems and Imaging, AIMS, 2018–.
- Guest editor, Applied and Computational Harmonic Analysis, Elsevier, 2015–2016.

Conference/Workshop Organization:

- Organizing Committee, SIAM Conference on Imaging Science (IS24), May 28–31, 2024, Atlanta, Georgia, USA.
- Organizing Committee, The China Conference on Scientific Machine Learning (CSML 2022), August 18-19, 2022, Beijing, China.
- Organizing Committee, Mathematical and Scientific Machine Learning (MSML 2022), August 15-17, 2022, Beijing, China.
- Program Committee, Mathematical and Scientific Machine Learning (MSML 2021), EPFL Campus, Lausanne, Switzerland, August 16-19, 2021.
- Program Committee, Mathematical and Scientific Machine Learning (MSML 2020), Princeton, USA, July 15-17, 2020.
- Organizing Committee, 1st International Workshop on Multiscale Multimodal Medical Imaging (MMMI2019), In conjunction with MICCAI 2019, October 13, 2019, Shenzhen, China.
- Organizing Committee, The Second National Conference on Big Data and Artificial Intelligence, CSIAM; minisymposium on “Deep Learning and PDEs”, Kunming, Yunnan, July 5-7, 2019.
- Organizing Committee, International Workshop on “Recent Advances on Mathematical Imaging and Data Science”, Shanghai Jiaotong University, July 3-5, 2019.
- Organizing Committee, CSIAM Annual Meeting, minisymposium on “Mathematical Theory, Models and Algorithms in Imaging Science: Medical Imaging and Image Analysis”, Chengdu, Sichuan, China, September 13–16, 2018.
- Organizing Committee, The 10th Annual Meeting on Inverse Problems, minisymposium on “Inverse Problems in Imaging Science”, Tianyuan Mathematical Center in Northeast China, Jilin University, Changchun, China, May 28–31, 2018.
- Organizing Committee, CSIAM Annual Meeting, minisymposium on “Mathematical Theory, Models and Algorithms in Imaging Science”, Qingdao, Shandong, China, October 12–15, 2017.
- Organizing Committee, PKU-NUS Joint Workshop on Deep Learning: Theory and Applications, Peking University, Beijing, China, August 27–28, 2017.
- Organizing Committee, PKU Summer School on Data Science, Peking University, Beijing, China, July 10-23, 2017.
- Organizing Committee, PKU Workshop on Computation and Big Data Analysis, Peking University, Beijing, China, June 20-21, 2017.
- Organizing Committee, 2016 International Workshop on Signal Processing, Optimization, and Compressed sensing, Nankai University, Tianjin, China, December 17-21, 2016.
- Organizing Committee, CSIAM Annual Meeting, minisymposium on “Mathematics in Image Processing and Analysis”, Xiang Tan, Hunan, China, August 12–14, 2016.
- Organizing Committee, Mathematics in Imaging Science and Data Analysis (MISDA), Peking University, Beijing, China, August 4-5, 2016.
- Organizing Committee, Computational Biomedical Imaging Workshop, Shanghai Jiaotong University, October 17-18, 2015.
- Program Committee, Wavelets and Sparsity XVI, SPIE Optics & Photonics 2015, August 9-13, 2015, San Diego, CA, USA.
- SIAM Conference on Imaging Science, minisymposium on “Mathematics of Medical Imaging and Shape Analysis, Part I, II, III” (MS28), May 20-22, 2012, Philadelphia, Pennsylvania, USA.

Conference/Workshop/Summer School Talks:

- Plenary talk. The 21st Annual Meeting of the China Society for Industrial and Applied Mathematics (CSIAM), Kunming, China, Oct. 12-15, 2023.
- Plenary talk. The 13th Annual Meeting of the China Society for Computational Mathematics (CSCM), Nanking, China, July 15-19, 2023.
- 45-minutes invited talk, International Congress of Mathematicians (ICM), July 6–14, 2022.
- Invited talk. “One World Mathematics of Information, Data, and Signals (1W-MINDS) seminar”, <https://sits.google.com/view/minds-seminar/home>, April 21, 2022.
- Invited talk. SIAM Conference on Imaging Science (IS22), mini-symposium on Geometry, Computing and Learning for Science and Engineering, March 23, 2022.

- Invited talk. DataSig Seminars Series. <https://www.datasig.ac.uk/events>, January 12, 2022.
- Invited talk. workshop on “Deep learning and partial differential equations”, the Isaac Newton Institute for Mathematical Sciences (INI), the University of Cambridge, November 15-19, 2021.
- Plenary talk. 3rd Annual “Deep Recon Workshop”, Massachusetts General Hospital and CAM-CA, Harvard University, November 14-15, 2021.
- Invited talk. “Computational Imaging Webinar Series - SPACE (Signal Processing And Computational image formation)”, IEEE Computational Imaging Technical Committee & IEEE Signal Processing Society, <https://sites.google.com/view/sps-space/home>, September 21, 2021.
- Invited talk. ”New trends in numerical multiscale methods and beyond”, Institut Mittag-Leffler, Djursholm, Sweden, July 12-July 16, 2021.
- Invited talk. “One World IMAGINE seminar series”, <https://sites.google.com/view/oneworldimagine>, July 1, 2021.
- Invited talk. ”Workshop on Mathematical Machine Learning and Applications”, Penn State University, December 14-16, 2020 (<http://sites.psu.edu/ccma/2020workshop/>).
- ”Workshop on AI & Mathematics”, Institute of Natural Sciences, SJTU, Dec 5-6, 2020.
- Invited talk, Webinar series on ”Mathematics, Physics and Machine Learning”, November 11, 2020. (<https://mpml.tecnico.ulisboa.pt/seminars>)
- Invited talk, One World Seminar Series in Imaging and Inverse Problem, July 1, 2020. (<https://sites.google.com/view/oneworldimagine>)
- Invited talk, SIAM Conference on Mathematics and Data Science, mini-symposium on Advances in Optimal Control and Machine Learning, June 23, 2020.
- Invited participation. Deep learning and partial differential equations, American Institute for Mathematics, San Jose, CA, October 14-18, 2019.
- Invited talk. The Third Conference on Scientific and Engineering Computing for Young Chinese Scientists, Beijing, China, August 17-21, 2019.
- Plenary talk. The Second National Conference on Big Data and Artificial Intelligence, CSIAM, Kunming, Yunnan, July 5-7, 2019.
- Plenary talk. The 11th National Conference on Inverse Problems, Imaging and Applications, Lanzhou, Gansu, June 22-24, 2019.
- Invited talk. The Third International Conference on Mathematics of Data Science (MathoDS 3), City University of Hong Kong (CityU), Hong Kong, China, June 19-23, 2019.
- Invited talk. Workshop on Machine Learning Techniques in Scientific Computing, Wuhan University, Hubei, June 17-19, 2019.
- Invited talk. Recent Development on Mathematical/statistical Approaches in Data Science, Dallas, TX, USA, June 1-2, 2019.
- Invited talk. Inverse Problems, Imaging and PDE’s, Institute for Advanced Studies, Hong Kong University of Science and Technology, Hong Kong, China May 20-24, 2019.
- Invited talk. “Deep Learning for Medical Imaging” in International Conference on Acoustics, Speech, and Signal Processing, Brighton, UK, May 12-17, 2019.
- Invited talk. Workshop on Geometry of Big Data, IPAM, UCLA, USA, April 29-May 3, 2019.
- Invited talk. Houston Big Data Conference (BigDIA), Houston, Texas, December 17-19, 2018.
- Invited talk. SIAM Annual Meeting. Minisymposium on “Machine Learning for Scientific Computing”, Portland, Oregon, USA, July 9–13, 2018.
- Invited talk. SIAM Conference on Imaging Science. Minisymposium on “Low-dimensional structures in imaging science” and “Graph Techniques for Image Processing”, Bologna, Italy, June 5–8, 2018.
- Invited talk. Inverse Problems, Imaging and PDEs, IAS, HKUST, Hong Kong, China, March 12–16, 2018.
- Invited talk. Workshop on Spline Approximation and its Applications on Carl de Boor’s 80th birthday, National University of Singapore, Singapore, December 4–8, 2017.
- Invited talk and lectures. Data Sciences: bridging mathematics, physics and biology, Institute for Mathematical Sciences, National University of Singapore, Singapore, May 29– June 16, 2017.
- Invited talk. 10th International Conference on Computational Physics, Macao, China, Jan. 16–20, 2017.

- Invited talk. International Conference on Some Mathematical Approximation Approaches in Data Science, Zhejiang University, Hangzhou, China, Dec. 12–14, 2016.
- Invited talk. International Conference on Applied Mathematics 2016, City University of Hong Kong, Hong Kong, China, May 30–June 2, 2016.
- Invited talk. SIAM Conference on Imaging Science, Albuquerque, NM, USA, May 23–26, 2016.
- Invited talk. Wavelets and Sparsity XVI, SPIE Optics & Photonics 2015. San Diego, CA, USA, August 9–13, 2015.
- Invited lecture (with Zuowei Shen). *Wavelet Frames and Applications*, Summer School at Kunming, Yunnan, China, July 13–24, 2015.
- Invited talk. International Workshop on Signal Processing, Optimization, and Control (SPOC 2014). National University of Defense Technology, Changsha, Hunan, China, Dec 22–26, 2014.
- Invited talk. Fifth International Conference on Computational Harmonic Analysis (ICCHA5), Nashville, Tennessee, USA, May 19–May 23, 2014.
- Invited talk. SIAM Conference on Imaging Science, minisymposium on “Computational inversion methods for biomedical imaging” (M48), Hong Kong Baptist University, Hong Kong, China, May 12–14, 2014.
- Invited lectures (with Zuowei Shen). Applied Mathematics Summer School, Peking University, Beijing, China, July 8–August 2, 2013.
- Invited talk. International Workshop on Scientific Computing for Young Chinese Mathematicians, CUHK, Hong Kong, China, March 15–17, 2013.
- Invited talk. Imaging Science, a workshop in honor of Stanley Osher. Tsinghua University, Beijing, China, December 15–19, 2012.
- Invited talk. Workshop on Signal Processing, Optimization, and Control, USTC, Hefei, China, July 1–4, 2012.
- Invited talk. SIAM Conference on Imaging Science, minisymposium on “Sparse and redundant representations for image reconstruction and geometry extraction” (MS67), May 20–22, 2012, Philadelphia, Pennsylvania, USA.
- Invited talk. Compressive Sensing Workshop: Leveraging Sparsity at UCLA & Beyond, UCLA, March 6–8, 2012.
- Invited talk, SIAM Conference on Analysis of Partial Differential Equations: Inverse Problems for Density Estimation and Medical Imaging, Nov. 14–Nov. 17, 2011, San Diego, CA, USA.
- Invited talk, International Workshop on “Recent Advances in Biomedical Imaging”, Shanghai Jiao Tong University, Aug. 15–19, 2011, Shanghai, China.
- Invited Lecture (with Zuowei Shen), Summer School 2011 on Medical Imaging and Applications, Shanghai Jiao Tong University, July 4–August 12, 2011, Shanghai, China.
- Invited talk, International Workshop on Image Processing, Computer Vision, Compressive sensing and Related Applications, International Institute for Mathematical Sciences, Dec 16–18, 2010, Seoul, Korea.
- Invited talk, Mathematical Aspects of Image Processing and Computer Vision 2010, Nov 25–27, 2010, Sapporo, Japan.
- Invited talk. *Some Mathematical Models in Biomedical Shape Processing and Analysis*, Pacific Rim Mathematics Conference, Mathematical Imaging Session, June 28–July 2, 2010, Stanford University, California, USA.
- Invited talk. *Surface reconstruction and biomedical shape processing and analysis*, SIAM Conference on Imaging Science, minisymposium on surface reconstruction and shading from sparse gradient fields, April 12–14, 2010, Chicago, Illinois, USA.
- Invited talk. *A nonlinear PDE-based method for sparse deconvolution*. The 20th International Symposium of Mathematical Programming, August 23–28, 2009, Chicago, Illinois, USA.
- Invited talk. *Level set based surface capturing in 3D medical images*. Midwest Conference on Mathematical Methods for Images and Surfaces, April 18–19, 2009, Michigan State University, Michigan, USA.
- Invited talk. *Level set based surface capturing in 3D medical images*. Workshop on Mathematical Imaging and Digital Media, Institute for Mathematical Sciences, June 16–20, 2008, Institute for Mathematical Sciences, National University of Singapore, Singapore.

- Invited talk. *Fast linearized Bregman iteration for compressive sensing and sparse denoising*. Chinese-French-Singaporean Joint Workshop on Wavelet Theory and Applications, Institute for Mathematical Sciences, June 9-13, 2008, Institute for Mathematical Sciences, National University of Singapore, Singapore.
- Invited talk. *Pseudo-splines, wavelets and framelets*. International Conference on Wavelet Theory and Applications: New Directions and Challenges, August 10-13, 2004, Institute for Mathematical Sciences, National University of Singapore, Singapore.