

REFERENCES

- [1] Y. K. Dewi, B. Aswar, J. F. Alam, D. Perencanaan, F. Teknik, and U. Hasanuddin, “Ekonomi Biru Indonesia untuk Perikanan Berkelanjutan,” vol. 8, pp. 47–57, 2025.
- [2] Fynnisa *et al.*, *Ekologi Perairan*. WIDINA MEDIA UTAMA, 2024.
- [3] M. A. Z. Fuad, A. F. Fajari, and N. Hidayati, “PEMODELAN DAN ANALISIS PERUBAHAN GARIS PANTAI DI KABUPATEN SITUBONDO, JAWA TIMUR,” *JFMR (Jurnal Penelit. Perikan. dan Kelautan) ournal Fish. Mar. Res.*, vol. 5, no. 2, pp. 335–349, 2021.
- [4] O. Repina *et al.*, “Evaluating five shoreline change models against 40 years of field survey data at an embayed sandy beach,” *Coast. Eng.*, vol. 199, no. December 2024, 2025, doi: 10.1016/j.coastaleng.2025.104738.
- [5] J. Kalthar and A. Itaya, “IDENTIFYING PRIORITY AREAS FOR COASTAL PROTECTION AROUND JAVA , Indonesia,” *J. SEGARA*, vol. 17, no. 1, pp. 43–56, 2021.
- [6] J. Lumban-gaol, J. Tetuko, S. Sumantyo, E. Tambunan, and D. Situmorang, “Sea Level Rise , Land Subsidence , and Flood Disaster Vulnerability Assessment : A Case Study in Medan City , Indonesia,” *Remote Sens.*, vol. 16, 2024.
- [7] Y. Mao and K. D. Splinter, “Application of SAR-Optical fusion to extract shoreline position from Cloud-Contaminated satellite images,” *ISPRS J. Photogramm. Remote Sens.*, vol. 220, no. January, pp. 563–579, 2025, doi: 10.1016/j.isprsjprs.2025.01.013.
- [8] A. S. Mahmoud, S. A. Mohamed, A. K. Helmy, and A. H. Nasr, “BDCN_UNet: Advanced shoreline extraction techniques integrating deep learning,” *Earth Sci. Informatics*, vol. 18, no. 2, 2025, doi: 10.1007/s12145-024-01693-w.
- [9] S. Bengoufa, S. Niculescu, M. K. Mihoubi, R. Belkessa, and K. Abbad, “Rocky shoreline extraction using a deep learning model and object-based image analysis,” *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci. - ISPRS Arch.*, vol. 43, no. B3-2021, pp. 23–29, 2021, doi: 10.5194/isprs-archives-XLIII-B3-2021-23-2021.

- [10] E. W. J. Bergsma *et al.*, “Shoreliner: A Sub-Pixel Coastal Waterline Extraction Pipeline for Multi-Spectral Satellite Optical Imagery,” *Remote Sens.*, vol. 16, no. 15, pp. 1–18, 2024, doi: 10.3390/rs16152795.
- [11] J. Zhang *et al.*, *A Comprehensive Survey with Quantitative Comparison of Image Analysis Methods for Microorganism Biovolume Measurements*, vol. 30, no. 1. Springer Netherlands, 2023. doi: 10.1007/s11831-022-09811-x.
- [12] W. Wawan, D. T. Harjanti, and Sulistyarini, “Analisis Perubahan Garis Pantai Menggunakan Metode DSAS di Desa Karimunting Kabupaten Bengkayang,” *Geodika J. Kaji. Ilmu dan Pendidik. Geogr.*, vol. 6, no. 1, pp. 121–131, 2022, doi: 10.29408/geodika.v6i1.5457.
- [13] F. O. Setyawan, W. K. Sari, and D. Aliviyanti, “Analisis Perubahan Garis Pantai Menggunakan Sistem Analisis Garis Pantai Digital Di Kecamatan Kuala Pesisir Kabupaten Nagan Raya Aceh,” *JFMR (Jurnal Penelit. Perikan. dan Kelautan)*, vol. 5, no. 2, pp. 368–377, 2021, [Online]. Available: <http://jfmr.ub.ac.id>
- [14] I. D. Setiawan, B. Baharuddin, and Y. Yuliyanto, “Pemetaan Perubahan Garis Pantai Menggunakan Citra Quickbird Dan Pengukuran Terestris Di Pantai Takisung Kabupaten Tanah Laut,” *Mar. Coast. Small Islands J. - J. Ilmu Kelaut.*, vol. 6, no. 1, 2022, doi: 10.20527/m.v6i1.11808.
- [15] M. Dimiyati, *Memahami Penginderaan Jauh Mandiri*. UI PUBLISHING, 2022.
- [16] N. Nila, Z. Cholidah, and L. Y. Irawan, “Pemanfaatan Penginderaan Jauh Untuk Pemetaan Alih Fungsi Lahan Sawah di Kabupaten Nganjuk,” *J. Geosains dan Remote Sens.*, vol. 5, no. 1, pp. 43–54, 2024, doi: 10.23960/jgrs.ft.unila.203.
- [17] A. Ambarwari, E. M. Husni, and D. Mahayana, “Perkembangan Metode Klasifikasi Citra Penginderaan Jauh dalam Perspektif Revolusi Ilmiah Thomas Kuhn Agus,” *J. Filsafat Indones.*, vol. 6, no. 3, pp. 465–473, 2023.
- [18] A. Tsokas, M. Rysz, P. M. Pardalos, and K. Dipple, “SAR data applications in earth observation: An overview,” *Expert Syst. Appl.*, vol. 205, no. April, 2022, doi: 10.1016/j.eswa.2022.117342.
- [19] F. Meyer, *The Synthetic Aperture Radar (SAR) Handbook: Comprehensive*

- Methodologies for Forest Monitoring and Biomass Estimation*. SERVIR Global Science Coordination Office, 2019. doi: 10.25966/nr2c-s697.
- [20] D. Amitrano, G. Di Martino, A. Di Simone, and P. Imperatore, “Flood Detection with SAR: A Review of Techniques and Datasets,” *Remote Sens.*, vol. 16, pp. 1–38, 2024, doi: 10.3390/rs16040656.
- [21] R. A. Nuryansah and S. Darmawan, “Identifikasi garis pantai pada citra satelit optis dan radar (studi kasus: pantai utara jawa barat),” *FTSP*, vol. 1, no. 1, p. 1300, 2023.
- [22] M. S. Wong, X. Zu, S. Abbas, C. Y. T. Kwok, and M. Wang, *Urban informatics*. Springer, Singapore, 2021. doi: https://doi.org/10.1007/978-981-15-8983-6_20.
- [23] D. Wan, R. Lu, S. Wang, S. Shen, T. Xu, and X. Lang, “YOLO-HR: Improved YOLOv5 for Object Detection in High-Resolution Optical Remote Sensing Images,” *Remote Sens.*, vol. 15, no. 3, 2023, doi: 10.3390/rs15030614.
- [24] X. Wang, L. Sun, A. Chehri, and Y. Song, “A Review of GAN-Based Super-Resolution Reconstruction for Optical Remote Sensing Images,” *Remote Sens.*, vol. 15, no. 20, pp. 1–34, 2023, doi: 10.3390/rs15205062.
- [25] J. Inglada, J. Michel, and O. Hagolle, “Assessment of the Usefulness of Spectral Bands for the Next Generation of Sentinel-2 Satellites by Reconstruction of Missing Bands,” *Remote Sens.*, vol. 14, pp. 1–24, 2022.
- [26] E. Cernadas, “Applications of Computer Vision, 2nd Edition,” *Electronics*, vol. 13, no. 18, pp. 275–422, 2024, doi: 10.1201/9781351248396-5.
- [27] X. Zhao, L. Wang, Y. Zhang, X. Han, M. Deveci, and M. Parmar, *A review of convolutional neural networks in computer vision*, vol. 57, no. 99. Springer Netherlands, 2024. doi: 10.1007/s10462-024-10721-6.
- [28] X. Wang and Z. Zhu, “Context understanding in computer vision: A survey,” *Comput. Vis. Image Underst.*, vol. 229, 2023, doi: <https://doi.org/10.1016/j.cviu.2023.103646>.
- [29] W. S. Negoro, A. H. Azhar, and R. A. Destari, “Understanding Digital Image Processing in Object Identification Against the Development of Information Technology,” *Maj. Ilm. J.*, vol. 32, no. 1, pp. 1–6, 2025.

- [30] K. R. Dongur, P. Tandekar, and S. K. Purve, "Digital Image Processing: Its History and Application," *Int. J. Adv. Res. Comput. Commun. Eng. ISO*, vol. 11, no. 6, p. 2, 2022, doi: 10.17148/IJARCCCE.2022.11672.
- [31] Z. Mahmood, "Digital Image Processing: Advanced Technologies and Applications," *Appl. Sci.*, vol. 14, no. 14, 2024, doi: 10.3390/app14146051.
- [32] A. Pranolo *et al.*, "Enhanced Multivariate Time Series Analysis Using LSTM: A Comparative Study of Min-Max and Z-Score Normalization Techniques," *Ilk. J. Ilm.*, vol. 16, no. 2, pp. 210–220, 2024, doi: 10.33096/ilkom.v16i2.2333.210-220.
- [33] S. Sinsomboonthong, "Performance Comparison of New Adjusted Min-Max with Decimal Scaling and Statistical Column Normalization Methods for Artificial Neural Network Classification," *Int. J. Math. Math. Sci.*, 2022, doi: 10.1155/2022/3584406.
- [34] F. Ramadhan, "Implementasi dan Analisa Image Scalling Menggunakan Bilinier Interpolation pada Citra Kendaraan," *J. Ilmu Komput. dan Sist. Inf.*, vol. 4, no. 3, pp. 329–343, 2025.
- [35] M. B. Pithani, S. Sanyal, and A. K. Shukla, "Bilinear and Bicubic Interpolations for Image Presentation of Mechanical Stress and Temperature Distribution," *Power Eng. Eng. Thermophys.*, vol. 1, no. 1, pp. 8–18, 2022, doi: 10.56578/peet010103.
- [36] D. Frommholz, "IMAGE INTERPOLATION ON THE CPU AND GPU USING LINE RUN SEQUENCES," *ISPRS Ann. Photogramm.*, vol. V, no. June, pp. 6–11, 2022.
- [37] Rasterio, "Georeferencing, rasterio documentation," Rasterio Docs. Accessed: May 20, 2026. [Online]. Available: <https://rasterio.readthedocs.io/en/latest/topics/georeferencing.html>
- [38] F. Muttaqin *et al.*, "A Combination Method of ROI , CLAHE , and DenseNet-169 for Hip Osteoarthritis Detection," vol. 15, no. 3, pp. 22690–22697, 2025.
- [39] L. Huawei Technologies Co., *Overview of Deep Learning*. Artificial Intelligence Technology. Springer, 2023. doi: 10.1007/978-981-19-2879-6_3.

- [40] R. K. Mishra, G. Y. S. Reddy, and H. Pathak, “The Understanding of Deep Learning: A Comprehensive Review,” *Math. Probl. Eng.*, vol. 2021, 2021, doi: 10.1155/2021/5548884.
- [41] H. Yang, M. Xu, Y. Chen, W. Wu, and W. Dong, “A Postprocessing Method Based on Regions and Boundaries Using Convolutional Neural Networks and a New Dataset for Building Extraction,” *Remote Sens.*, vol. 14, no. 3, 2022, doi: 10.3390/rs14030647.
- [42] J. He, S. Zhang, M. Yang, Y. Shan, and T. Huang, “BDCN: Bi-Directional Cascade Network for Perceptual Edge Detection,” *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 44, no. 1, pp. 100–113, 2022, doi: 10.1109/TPAMI.2020.3007074.
- [43] A. Huang, L. Jiang, J. Zhang, and Q. Wang, “Attention-VGG16-UNet: a novel deep learning approach for automatic segmentation of the median nerve in ultrasound images,” *Quant. Imaging Med. Surg.*, vol. 12, no. 6, pp. 3138–3150, 2022, doi: 10.21037/qims-21-1074.
- [44] R. Azad *et al.*, “Medical Image Segmentation Review: The Success of U-Net,” *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 46, no. 12, pp. 10076–10095, 2024, doi: 10.1109/TPAMI.2024.3435571.
- [45] I. Konovalenko, P. Maruschak, J. Brezinova, O. Prentkovskis, and J. Brezina, “Research of U-Net-Based CNN Architectures for Metal Surface Defect Detection,” *Machines*, vol. 10, no. 5, 2022, doi: 10.1201/b15870-17.
- [46] M. Sobhana, G. S. D. Kumar, Y. Tejaswi, and P. Pakkuru, “Detecting Urban Road Changes using Segmentation and Vector Analysis,” *Indones. J. Electr. Eng. Informatics*, vol. 11, no. 3, pp. 630–642, 2023, doi: 10.52549/ijeei.v11i3.4662.
- [47] M. S. Neyestanak *et al.*, “A Quantitative Comparison between Focal Loss and Binary Cross-Entropy Loss in Brain Tumor Auto-Segmentation Using U-Net,” *J. Biostat. Epidemiol.*, vol. 11, no. 1, pp. 15–35, 2025, doi: 10.18502/jbe.v11i1.19315.
- [48] G. Hu, “A Mathematical Survey of Image Deep Edge Detection Algorithms: From Convolution to Attention,” *Mathematics*, vol. 13, no. 15, 2025, doi: 10.3390/math13152464.

- [49] M. Yeung, L. Rundo, Y. Nan, E. Sala, C. B. Schönlieb, and G. Yang, “Calibrating the Dice Loss to Handle Neural Network Overconfidence for Biomedical Image Segmentation,” *J. Digit. Imaging*, vol. 36, no. 2, pp. 739–752, 2023, doi: 10.1007/s10278-022-00735-3.
- [50] S. Kato and K. Hotta, “Adaptive t-vMF dice loss: An effective expansion of dice loss for medical image segmentation,” *Comput. Biol. Med.*, vol. 168, p. 107695, 2024, doi: 10.1016/j.compbiomed.2023.107695.
- [51] R. Polaki, P. K. Rangarajan, G. Pallavi, E. Rajasekhar, and A. Altalbe, “A fusion of cross-shaped window attention block and enhanced 3D U-Net for brain tumor segmentation,” *Int. J. Electr. Comput. Eng.*, vol. 14, no. 6, pp. 7103–7115, 2024, doi: 10.11591/ijece.v14i6.pp7103-7115.
- [52] W. A. F. Koman, A. S. Izza, and D. Candraningtyas, “Perbandingan Parameter Segmentasi OBIA dalam Klasifikasi Tutupan Lahan,” *J. Paradig. J. Multidisipliner Mhs. Pascasarj. Indones.*, vol. 3, no. 2, pp. 104–113, 2022.
- [53] O. S. Azeez, H. Z. M. Shafri, A. H. Alias, and N. A. B. Haron, “Integration of Object-Based Image Analysis and Convolutional Neural Network for the Classification of High-Resolution Satellite Image: A Comparative Assessment,” *Appl. Sci.*, vol. 12, no. 21, 2022, doi: 10.3390/app122110890.
- [54] C. Cechim Junior, H. Araki, and R. de Campos Macedo, “OBIA and Machine Learning (ML) Applied to Tropical Forest Mapping Using Sentinel-2,” *Can. J. Remote Sens.*, vol. 49, no. 1, 2023, doi: 10.1080/07038992.2023.2259504.
- [55] R. V. Sukmaningsih, B. H. Iswanto, and H. Suhendar, “KLASIFIKASI KERUSAKAN JALAN RAYA BERBASIS CITRA UDARA MENGGUNAKAN OBJECT-BASED IMAGE-ANALYSIS (OBIA),” *Pros. Semin. Nas. Fis.*, vol. 12, 2024, doi: Prosiding Seminar Nasional Fisika (E-Journal) DOI: doi.org/10.21009/03.1201.FA05.
- [56] N. Wang, F. Chen, B. Yu, and L. Wang, “A Strategy of Parallel SLIC Superpixels for Handling Large-Scale Images over Apache Spark,” *Remote Sens.*, vol. 14, no. 7, 2022, doi: 10.3390/rs14071568.
- [57] J. Nowosad and T. F. Stepinski, “International Journal of Applied Earth Observation and Geoinformation Extended SLIC superpixels algorithm for applications to non-imagery geospatial rasters,” *Int. J. of Applied Earth Obs.*

- Geoinf.*, vol. 112, no. June, 2022.
- [58] J. Laonamsai *et al.*, “Utilizing NDWI, MNDWI, SAVI, WRI, and AWEI for Estimating Erosion and Deposition in Ping River in Thailand,” *Hydrology*, vol. 10, no. 3, pp. 1–25, 2023, doi: 10.3390/hydrology10030070.
- [59] Y. Ma *et al.*, “Evaluating the Ability of the Sentinel-1 Cross-Polarization Ratio to Detect Spring Maize Phenology Using Adaptive Dynamic Threshold,” *Remote Sens.*, vol. 16, no. 5, pp. 1–22, 2024, doi: 10.3390/rs16050826.
- [60] A. Vanacore, M. S. Pellegrino, and A. Ciardiello, “Fair evaluation of classifier predictive performance based on binary confusion matrix,” *Comput. Stat.*, vol. 39, no. 1, pp. 363–383, 2024, doi: 10.1007/s00180-022-01301-9.
- [61] M. R. Syazali and E. Yulianti, “Classification of Economic Activities in Indonesia Using IndoBERT Language Model,” *J. Ilmu Komput. dan Inf.*, vol. 18, no. 2, pp. 155–165, 2025, doi: 10.21609/jiki.v18i2.1446.
- [62] P. Le Jeune and A. Mokraoui, “Extension of Intersection over Union to Improve Small Object Detection in Few-Shot Regime,” *EUSIPCO*, pp. 1787–1791, 2025.
- [63] D. I. Mulyana and Marjuki, “Optimasi Prediksi Harga Udang Vaname dengan Metode RMSE dan MAE Dalam Algoritma Regresi Linier,” *J. Ilm. Betrik*, vol. 13, no. 01, pp. 50–58, 2022.
- [64] D. J. Evan and P. O. N. Saian, “Implementasi Python Framework Flask Pada Modul Transfer Out Toko Di Pt Xyz,” *JUPI (Jurnal Ilm. Penelit. dan Pembelajaran Inform.*, vol. 8, no. 4, pp. 1121–1131, 2023, doi: 10.29100/jipi.v8i4.4020.
- [65] E. S. Agency, “Copernicus Data Space Ecosystem (CDSE).” [Online]. Available: <https://dataspace.copernicus.eu/>
- [66] Badan Informasi Geospasial (BIG), “Rupa Bumi Indonesia (RBI) skala 1:25.000 Kabupaten Tuban.” [Online]. Available: <https://tanahair.indonesia.go.id/portal-web/>