

REFERENCES

- [1] W. H. Organization, “Global strategy on digital health 2020–2025,,” *WHO*, 2022.
- [2] R. Zhang and Others, “Visually Meaningful Image Encryption Algorithm Based on Parallel Compressive Sensing and Cellular Neural Network,” in *Springer Singapore*, vol. 250, no. November, 2022.
- [3] X. Huang, Y. Dong, G. Ye, W.-S. Yap, and B.-M. Goi, “Visually meaningful image encryption algorithm based on digital signature,” *Digit. Commun. Networks*, vol. 9, pp. 159–165, 2023.
- [4] T. Li, B. Du, and X. Liang, “Image Encryption Algorithm Based on Logistic and Two-Dimensional Lorenz,” *IEEE Access*, vol. 8, pp. 13 792–13 805, 2020.
- [5] R. Hamza, K. Muhammad, A. Kumar, and G. Ramirez-Gonzalez, “Hash Based Encryption for Keyframes of Diagnostic Hysteroscopy,” *IEEE Access*, vol. 6, no. November, pp. 60 160–60 170, 2017.
- [6] F. Wang, H. Xu, and Y. Li, “Color Image Encryption Algorithm Based on Lorenz Hyperchaotic System,” in *ACM Int. Conf. Proceeding Ser.*, vol. 18, no. 5, 2021, pp. 380–384.
- [7] A. Abd-Elazeem, M. Elsharkawy, and A. Saleh, “Medical image encryption using chaotic maps and DCT,” *Int. J. Comput. Appl.*, vol. 975, no. 8887, pp. 1–6, 2020.
- [8] E. N. Uche-Anyia and Others, “Video Endoscopy as Big Data: Balancing Privacy and Progress in Gastroenterology,” *Am. J. Gastroenterol.*, vol. 119, no. 4, pp. 600–603, 2024.
- [9] D. S. Committee, “Digital Imaging and Communications in Medicine (DICOM) Standard,” 2023.
- [10] Z. Whittaker, “A billion medical images are exposed online, as doctors ignore warnings,” *TechCrunch*, 2020.

- [11] J. Gillum and Others, “Millions of Americans’ Medical Images and Data Are Available on the Internet. Anyone Can Take a Peek,” *ProPublica*, 2019.
- [12] K. Mirsky and Others, “CT-GAN: Malicious Tampering of 3D Medical Imagery using Deep Learning,” *Proc. 28th USENIX Secur. Symp.*, 2019.
- [13] S. Janakiraman and Others, “Integrity verified lightweight ciphering for secure medical image sharing between embedded SoCs,” *Sci. Rep.*, vol. 15, p. 7465, 2025.
- [14] G. Li, X. Chai, Z. Gan, and Others, “Exploiting one-dimensional exponential Chebyshev chaotic map and matching embedding for visually meaningful image encryption,” *Chaos Solitons Fractals*, vol. 176, p. 114111, 2023.
- [15] Y. Wang, X. Zhang, and W. Li, “Image Encryption Algorithms: A Survey and Comparison,” *IEEE Access*, vol. 7, pp. 110 485–110 507, 2019.
- [16] L. Li, M. Qiu, and Others, “Secure Medical Image Sharing with Hybrid DWT-DCT Encryption Scheme,” *J. Healthc. Eng.*, vol. 2020, p. 8832105, 2020.
- [17] M. Ahmad and R. Shah, “A Novel Image Encryption Scheme Based on Chaotic Maps and Permutation-Diffusion,” *Multimed. Tools Appl.*, vol. 80, pp. 19 411–19 433, 2021.
- [18] J. Wang, H. Wang, and Z. Wang, “Performance Comparison of AES and Chaos-based Encryption in Medical Imaging,” *IEEE Trans. Inf. Technol. Biomed.*, vol. 24, no. 6, pp. 1824–1831, 2020.
- [19] X. Chai, G. Li, and Others, “Visually Meaningful Image Encryption Based on Chebyshev Chaotic Map and Adaptive Embedding,” *Chaos, Solitons & Fractals*, vol. 176, p. 114111, 2023.
- [20] S. M. A. Ebrahim, “Hybrid chaotic method for medical images ciphering,” *CoRR*, vol. abs/2012.02865, 2020. [Online]. Available: <https://arxiv.org/abs/2012.02865>
- [21] A. Jan, S. A. Parah, M. Hussan *et al.*, “Double layer security using crypto-stego techniques: a comprehensive review,” *Health Technology*, vol. 12, pp. 9–31, 2022. [Online]. Available: <https://doi.org/10.1007/s12553-021-00602-1>

- [22] P. Liu, Z. Zhu, H. Wang, and T. Yan, "A novel image steganography using chaotic map and visual model," *International Journal of Computational Intelligence Systems*, 10 2007.
- [23] B. Abd-El-Atty, "A robust medical image steganography approach based on particle swarm optimization algorithm and quantum walks," *Neural Computing and Applications*, vol. 35, pp. 773–785, 2023. [Online]. Available: <https://doi.org/10.1007/s00521-022-07830-0>
- [24] S. Ghosh, A. Saha, T. Pal, and A. K. Jha, "A comparative analysis of chaos theory based medical image steganography to enhance data security," *Procedia Computer Science*, vol. 235, pp. 1024–1033, 2024, presented at International Conference on Machine Learning and Data Engineering (ICMLDE 2023). [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S187705092401139X>
- [25] X. Li and H. Peng, "Chaotic medical image encryption method using attention mechanism fusion resnet model," *Frontiers in Neuroscience*, vol. 17, p. 1226154, July 2023. [Online]. Available: <https://www.frontiersin.org/articles/10.3389/fnins.2023.1226154>
- [26] Y. Zhang and Others, "Image Encryption Using Chaotic Maps: A Survey," *Entropy*, vol. 21, no. 6, pp. 1–20, 2019.
- [27] X. Fu and Others, "A Chaos-Based Image Encryption Scheme Combining Permutation and Diffusion," *Signal Process. Image Commun.*, vol. 92, p. 116121, 2021.
- [28] A. Kanso and M. Smaoui, "Logistic Chaotic Map for Binary Image Encryption," *Chaos Solitons Fractals*, vol. 138, 2020.
- [29] L. Lin, Q. Wang, and Y. He, "Efficient Image Encryption Based on 3D Chaotic Maps with Permutation-Diffusion Structure," *IEEE Access*, vol. 10, pp. 7773–7784, 2022.
- [30] J. Gao, H. Xu, and Y. Zhao, "Multi-round chaotic permutation and diffusion-based medical image encryption," *Multimed. Tools Appl.*, vol. 82, pp. 37 625–37 645, 2023.
- [31] C. Fu and Others, "A Review of Image Encryption and Decryption Techniques," *IEEE Access*, vol. 9, pp. 75 055–75 078, 2021.

- [32] X. Luo, J. Liu, and Z. Cao, "Reversible Image Encryption with Pixel Reordering and Hybrid Diffusion," *Signal Process. Image Commun.*, vol. 95, p. 116231, 2021.
- [33] T. Ahmed and Others, "Medical Image Decryption and Authentication Using Hybrid DWT and Digital Signature," *Multimed. Tools Appl.*, vol. 80, pp. 27 457–27 478, 2021.
- [34] D. Wu and Others, "High-Sensitivity Medical Image Decryption Scheme Based on 3D Chaos and Adaptive Control," *IEEE Trans. Ind. Informatics*, vol. 17, no. 6, pp. 4005–4015, 2021.
- [35] Y. Liu and Others, "Quality Evaluation Metrics for Medical Image Encryption and Recovery: A Review," *J. Imaging*, vol. 7, no. 1, p. 3, 2021.
- [36] H. El-Sayed and Others, "Secure Medical Image Encryption Using Hybrid Chaos-Based and AES Algorithm for Cloud Storage," *IEEE Access*, vol. 9, pp. 126 022–126 035, 2021.
- [37] M. Khan and Others, "End-to-End Medical Image Encryption with Chaotic Maps and Watermark Authentication," *Multimed. Tools Appl.*, vol. 81, pp. 12 345–12 370, 2022.
- [38] X. Chai and Others, "Visual Meaningful Encryption of Medical Images with DWT and Chebyshev Map," *Chaos, Solitons & Fractals*, vol. 176, p. 114111, 2023.
- [39] A. A. Mahdi and Others, "A Secure and Efficient Medical Image Encryption Scheme for Telemedicine Applications," *IEEE Trans. Ind. Informatics*, vol. 18, no. 4, pp. 2753–2761, 2022.
- [40] E. Ott, *Chaos in Dynamical Systems*, 2nd ed. Cambridge University Press, 2019.
- [41] M. S. Baptista, "Cryptography with chaos," *Phys. Lett. A*, vol. 240, no. 1–2, pp. 50–54, 2020.
- [42] H. Liu and X. Wang, "Color Image Encryption Using Spatial Chaotic System and Permutation-Diffusion Architecture," *IEEE Access*, vol. 8, pp. 34 562–34 575, 2020.
- [43] A. Pisarchik and M. Zanin, "Chaotic systems for cryptographic applications: A review," *Entropy*, vol. 22, no. 6, p. 615, 2020.

- [44] R. Q. Fei and Others, “Secure image encryption using 3D chaotic maps and genetic mutation strategy,” *Multimed. Tools Appl.*, vol. 80, pp. 11 279–11 302, 2021.
- [45] N. Zhou and Others, “A novel image encryption scheme based on logistic-sine chaotic map and DWT,” *Signal Process. Image Commun.*, vol. 93, p. 116170, 2021.
- [46] Y. Li and Others, “Lightweight chaos-based encryption for real-time medical image protection,” *IEEE Internet Things J.*, vol. 9, no. 2, pp. 1046–1058, 2022.
- [47] E. Lorenz, “Deterministic Nonperiodic Flow,” *J. Atmos. Sci.*, vol. 20, no. 2, pp. 130–141, 1963.
- [48] S. S. Kashyap, R. A. Dandekar, R. Dandekar, and S. Panat, “Modeling chaotic Lorenz ODE System using Scientific Machine Learning,” *arXiv*, 2024.
- [49] G. Chen and T. Ueta, “Yet Another Chaotic Attractor,” *Int. J. Bifurc. Chaos*, vol. 9, no. 7, pp. 1465–1466, 2019.
- [50] X. Zhu and Others, “Sensitivity and Parameter Analysis of Lorenz Chaotic System in Image Encryption,” *IEEE Access*, vol. 8, pp. 107 203–107 215, 2020.
- [51] L. Liu, J. Sun, and D. Wu, “A Medical Image Encryption Algorithm Based on Hyperchaotic Lorenz System,” *IEEE Trans. Ind. Informatics*, vol. 18, no. 10, pp. 6785–6795, 2022.
- [52] H. Xu and Others, “A Triple-Chaotic Map Image Encryption Algorithm Based on 3D Lorenz Structure,” *Multimed. Tools Appl.*, vol. 80, pp. 17 895–17 919, 2021.
- [53] J. Yu and Others, “Real-Time Chaos-Based Image Protection for Medical Data Using Modified Lorenz System,” *IEEE Internet Things J.*, vol. 10, no. 3, pp. 2254–2264, 2023.
- [54] C. Fu and Others, “A Review of Chaos-Based Image Encryption Techniques,” *IEEE Access*, vol. 9, pp. 75 055–75 078, 2021.
- [55] W. Liu and Others, “3D Lorenz System-Based Permutation for Medical Image Encryption,” *Multimed. Tools Appl.*, vol. 80, pp. 17 901–17 924, 2021.

- [56] J. Zhang, H. Ma, and Z. Liu, "Triple-Lorenz Based Visual Encryption Scheme with High Entropy," *Entropy*, vol. 22, no. 4, p. 434, 2020.
- [57] Y. Wang, X. Zhang, and Y. Zhao, "Image Diffusion with Chaotic Sequences Derived from Lorenz Attractor," *Signal Process. Image Commun.*, vol. 89, p. 115952, 2020.
- [58] R. Kumar and Others, "Medical Image Encryption Using 3D Chaos for High-Resolution RGB and Grayscale Images," *Health Informatics J.*, vol. 27, no. 1, pp. 22–33, 2021.
- [59] M. Han and Others, "Visual Meaningful Encryption in Wavelet Domain Using Chaotic Lorenz Mask," *J. Inf. Secur. Appl.*, vol. 58, p. 102774, 2021.
- [60] F. Li and G. Chai, "A Novel Triple-Stage Permutation–Diffusion Encryption Based on Lorenz Chaotic Map," *IEEE Trans. Multimed.*, vol. 23, pp. 3125–3137, 2021.
- [61] A. Cheddad and Others, "Digital image steganography: Survey and analysis of current methods," *Signal Processing*, vol. 90, no. 3, pp. 727–752, 2020.
- [62] B. Subhedar and V. Mankar, "Current status and key issues in image steganography: A survey," *Comput. Sci. Rev.*, vol. 13, pp. 95–113, 2021.
- [63] M. Hussain and Others, "A survey of image steganography techniques in cloud computing and medical imaging," *J. Netw. Comput. Appl.*, vol. 133, pp. 75–89, 2020.
- [64] D. Bedi and Others, "Performance analysis of various image steganography techniques: A comparative study," *Multimed. Tools Appl.*, vol. 79, pp. 13 319–13 351, 2020.
- [65] R. Sharma and V. Srivastava, "Robust image steganography technique for medical data security using hybrid optimization," *Comput. Biol. Med.*, vol. 136, p. 104709, 2021.
- [66] Y. Li and Others, "Intelligent adaptive image steganography based on edge detection and texture features," *IEEE Access*, vol. 8, pp. 164 601–164 614, 2020.
- [67] F. Khan and Others, "Securing Medical Images through Hybrid Encryption and Steganography: A Review," *Health Informatics J.*, vol. 28, no. 2, pp. 1056–1070, 2022.

- [68] J. Fridrich, “Applications of data hiding in digital images,” in *Proc. SPIE*, vol. 5020, 2020, pp. 11–28.
- [69] A. Tiwari and P. Johari, “A Survey on LSB based Steganography Techniques in Spatial Domain,” *Procedia Comput. Sci.*, vol. 167, pp. 1261–1270, 2020.
- [70] H. Malik and Others, “Robustness Analysis of Spatial Domain Image Steganography under Signal Processing Attacks,” *J. Inf. Secur. Appl.*, vol. 55, p. 102609, 2021.
- [71] S. Patel and Others, “Secure image steganography using DWT and DCT,” *J. King Saud Univ. – Comput. Inf. Sci.*, vol. 34, no. 5, pp. 1843–1854, 2022.
- [72] M. A. Khan and M. Nauman, “Comparative Analysis of Steganographic Techniques Based on Frequency and Spatial Domains,” *Multimed. Tools Appl.*, vol. 80, pp. 12 777–12 804, 2021.
- [73] A. Khan and Others, “A Secure and Robust Method of Medical Image Steganography using DWT and SVD,” *Biomed. Signal Process. Control*, vol. 69, p. 102804, 2021.
- [74] L. Yu and Others, “Deep learning-based adaptive steganography in medical images,” *IEEE Access*, vol. 10, pp. 21 476–21 487, 2022.
- [75] S. Mallat, “A theory for multiresolution signal decomposition: the wavelet representation,” *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 11, no. 7, pp. 674–693, 1989.
- [76] M. Qureshi and Others, “A comprehensive review on visually meaningful image encryption schemes,” *IEEE Access*, vol. 9, pp. 30 415–30 435, 2021.
- [77] M. Hussain and Others, “Medical Image Steganography Using Wavelet Transform and Genetic Optimization,” *Multimed. Tools Appl.*, vol. 80, pp. 19 413–19 437, 2021.
- [78] H. Li and J. Chen, “Secure Medical Image Sharing Based on DWT and Signature Authentication,” *J. Inf. Secur. Appl.*, vol. 56, p. 102644, 2021.
- [79] T. Nguyen and J. Lee, “Security assessment of VMEI using visual-based attacks,” *Comput. Secur.*, vol. 109, p. 102388, 2021.
- [80] W. Lin and Others, “Secure Image Authentication Scheme Using DWT and RSA for Medical Records,” *Comput. Biol. Med.*, vol. 124, p. 103928, 2020.

- [81] F. Khan and Others, “Visual Meaningful Encryption for Medical Images Using Multi-Stage Wavelet Embedding,” *IEEE Access*, vol. 10, pp. 19 402–19 418, 2022.
- [82] A. Menezes, P. van Oorschot, and S. Vanstone, *Handbook of Applied Cryptography*. CRC Press, 2020.
- [83] M. Ahmed, A. Khan, and F. Hussain, “Digital Signature for Medical Image Authentication: A Review,” *IEEE Access*, vol. 8, pp. 192 045–192 060, 2020.
- [84] X. Wang, J. Zhang, and H. Liu, “Robust and Secure Signature Embedding Using DWT and Chaos in Medical Images,” *J. Inf. Secur. Appl.*, vol. 55, p. 102580, 2021.
- [85] H. Li, Y. Liu, and J. Wu, “RSA-Based Signature Integration in Medical Image Steganography Using Wavelet,” *IEEE Access*, vol. 9, pp. 145 302–145 313, 2021.
- [86] L. Zhang, K. Huang, and Y. Zhao, “Visual Signature Integration in Encrypted Medical Images,” *Multimed. Tools Appl.*, vol. 81, no. 5, pp. 6937–6958, 2022.
- [87] Y. Liu, F. Zhang, and H. Chen, “Chaos and DWT-SVD Based Signature Steganography in Telemedicine,” *Biomed. Signal Process. Control*, vol. 70, p. 103038, 2021.
- [88] A. Sharma, R. Saini, and M. Kumar, “A Blockchain-Based System for Medical Image Signature and Storage,” *IEEE Internet Things J.*, vol. 9, no. 7, pp. 4856–4865, 2022.
- [89] B. Park and D. Lee, “Biometric-Driven Digital Signature for Secure Image Authentication,” *IEEE Sens. J.*, vol. 21, no. 12, pp. 13 710–13 718, 2021.
- [90] T. Alharbi, M. Khan, and S. Khan, “Revocation Mechanism in Digital Certificate for Medical Information Systems,” *Comput. Biol. Med.*, vol. 132, p. 104320, 2021.
- [91] J. Fridrich, “Visual cryptography and meaningful encryption,” *IEEE Signal Process. Mag.*, vol. 36, no. 5, pp. 44–54, 2020.
- [92] H. Wu and Others, “Meaningful encryption using Arnold and DWT for medical images,” *Biomed. Signal Process. Control*, vol. 58, p. 101872, 2020.

- [93] R. Pathak and N. Tiwari, "Chaotic map-based meaningful encryption using DWT and SVD," *Multimed. Tools Appl.*, vol. 80, no. 9, pp. 13 657–13 679, 2021.
- [94] W. Zhou and Others, "Cover selection criteria for meaningful image encryption: A frequency domain analysis," *J. Vis. Commun. Image Represent.*, vol. 77, p. 103116, 2022.
- [95] H. Li and Others, "Secure EMR images using embedded digital signature and DWT-based VMEI," *J. Inf. Secur. Appl.*, vol. 59, p. 102843, 2021.
- [96] Z. Zhao and Others, "Adaptive cipher image system for healthcare cloud using VMEI," *Heal. Informatics J.*, vol. 27, no. 4, pp. 1463–1475, 2021.
- [97] A. Khan and Others, "PSNR-Entropy tradeoff in chaos-based VMEI systems," *Multimed. Tools Appl.*, vol. 81, pp. 29 321–29 340, 2022.
- [98] F. Wang and Others, "Deep learning-based adaptive meaningful encryption for medical images," *IEEE Access*, vol. 10, pp. 17 329–17 342, 2022.
- [99] M. Akbar and Others, "Entropy-preserving visual encryption scheme using Lorenz map and hybrid transform," *IEEE Access*, vol. 9, pp. 132 476–132 490, 2021.
- [100] H. Kong, W. Gao, X. Du *et al.*, "An improved non-local means algorithm for ct image denoising," *Multimedia Systems*, vol. 30, p. 79, 2024.
- [101] X. Wang, J. Tian, Y. Yu, Q. Wang, Y. Feng, I. Agbenu, Y. Su, and Z. Zhang, "Nlifd: improved non-local mean filtering algorithm for infrared face image denoising," *Physica Scripta*, vol. 100, 06 2025.
- [102] L. Yu and Others, "VMEI with blockchain-enabled authentication for smart healthcare," *IEEE Internet Things J.*, vol. 9, no. 5, pp. 4105–4116, 2022.
- [103] J. Wang and Others, "Adaptive DWT Embedding for Medical Images Using Deep Learning Guidance," *IEEE Trans. Biomed. Circuits Syst.*, vol. 15, no. 4, pp. 764–774, 2021.
- [104] S. Mallat, *A Wavelet Tour of Signal Processing: The Sparse Way*. Academic Press, 2020.
- [105] L. Zhou and Others, "Chaos-Based Visual Meaningful Encryption Using DWT and Multi-Level Signature," *IEEE Access*, vol. 9, pp. 154 523–154 536, 2021.

- [106] H. Li and Others, “RSA-Based Signature Integration in Medical Image Steganography Using Wavelet,” *IEEE Access*, vol. 9, pp. 145 302–145 313, 2021.
- [107] S. John and S. N. Kumar, “2d lorentz chaotic model coupled with logistic chaotic model for medical image encryption: Towards ensuring security for teleradiology,” in *Procedia Computer Science*, vol. 218, 2022, pp. 918–926.
- [108] P. A, U. R, J. N, and P. S, “Securing medical images using chaotic map encryption and lsb steganography,” in *Proceedings of the 2021 1st International Conference on Advanced Electrical, Computing, Communication and Sustainable Technologies*, vol. 38, no. 1, 2024, pp. 313–321.
- [109] K. C. Darmawan, I. Wahidah, R. Y. N. F, and M. Sc, “Perancangan dan analisis audio watermarking berbasis modified discrete cosine transform dengan metode stationary wavelet transform dan centroid video watermarking using modified singular value decomposition (svd) in domain frequency,” *e-Proceeding Engineering*, vol. 7, no. 2, pp. 4251–4255, 2020.
- [110] R. Kumar, P. Agrawal, and V. Bhatt, “Histogram-equalized AES encryption for telemedicine systems,” *J. Med. Syst.*, vol. 46, no. 1, pp. 1–9, 2022.