

## DAFTAR PUSTAKA

- [1] C.-C. Hsu, R.-Y. Hou, and W.-Y. Wang, "Path Planning for Mobile Robots Based on Improved Ant Colony Optimization," in *2013 IEEE International Conference on Systems, Man, and Cybernetics*, 2013, pp. 2777–2782.
- [2] F. Jin and G. Shu, "Path planning of free-flying space robot based on artificial bee colony algorithm," in *Proceedings of 2012 2nd International Conference on Computer Science and Network Technology*, 2012, no. 2, pp. 505–508.
- [3] M. H. Saffari and M. J. Mahjoob, "Bee colony algorithm for real-time optimal path planning of mobile robots," in *2009 Fifth International Conference on Soft Computing, Computing with Words and Perceptions in System Analysis, Decision and Control*, 2009, pp. 1–4.
- [4] Y. Cheng, P. Jiang, and Y. F. Hu, "A distributed snake algorithm for mobile robots path planning with curvature constraints," in *2008 IEEE International Conference on Systems, Man and Cybernetics*, 2008, pp. 2056–2062.
- [5] H. Brahmi, B. Ammar, and A. M. Alimi, "Intelligent path planning algorithm for autonomous robot based on recurrent neural networks," in *2013 International Conference on Advanced Logistics and Transport*, 2013, pp. 199–204.
- [6] R. Shakiba, M. Najafipour, and M. E. Salehi, "An improved PSO-based path planning algorithm for humanoid soccer playing robots," in *2013 3rd Joint Conference of AI & Robotics and 5th RoboCup Iran Open International Symposium*, 2013, pp. 1–6.
- [7] C. Cimpanu and L. Ferariu, "Genetic multiobjective fitness assignment scheme applied to robot path planning," in *2013 International Conference on Electronics, Computer and Computation (ICECCO)*, 2013, pp. 196–199.
- [8] Nguyet Tran, Duy-Tung Nguyen, Duc-Lung Vu, and Nguyen-Vu Truong, "Global path planning for autonomous robots using modified visibility-graph," in *2013 International Conference on Control, Automation and Information Sciences (ICCAIS)*, 2013, pp. 317–321.
- [9] H. Xu, X. Xu, Y. Li, X. Zhu, C. Song, and L. Wang, "A method for path planning of autonomous robot using A\* algorithm," in *2013 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 2013, no. December, pp. 2322–2327.
- [10] C.-C. Lin, W.-J. Chuang, and Y.-D. Liao, "Path Planning Based on Bezier Curve for Robot Swarms," in *2012 Sixth International Conference on Genetic and Evolutionary Computing*, 2012, vol. 1, pp. 253–256.
- [11] H. Dong, W. Li, J. Zhu, and S. Duan, "The Path Planning for Mobile Robot Based on Voronoi Diagram," in *2010 Third International Conference on Intelligent Networks and Intelligent Systems*, 2010, pp. 446–449.



- [12] N. O. Eraghi, F. Lopez-Colino, A. de Castro, and J. Garrido, "Path length comparison in grid maps of planning algorithms: HCTNav, A\* and Dijkstra," in *Design of Circuits and Integrated Systems*, 4795, pp. 1–6.
- [13] E. J. Gomez, F. M. Santa, and F. H. M. Sarmiento, "A comparative study of geometric path planning methods for a mobile robot: Potential field and voronoi diagrams," in *2013 II International Congress of Engineering Mechatronics and Automation (CIIMA)*, 2013, pp. 1–6.
- [14] O. Khatib, "Real time obstacle avoidance for manipulators and mobile robots," *International Journal of Robotics and Research*, vol. 5, no. 1. pp. 90–98, 1986.
- [15] D. H. Kim, "Escaping route method for a trap situation in local path planning," *Int. J. Control. Autom. Syst.*, vol. 7, no. 3, pp. 495–500, 2009.
- [16] P. Shi and Y. Zhao, "Global path planning for mobile robot based on improved artificial potential function," in *2009 IEEE International Conference on Automation and Logistics*, 2009, pp. 1900–1904.
- [17] Qian Jia and Xingsong Wang, "Path planning for mobile robots based on a modified potential model," in *2009 International Conference on Mechatronics and Automation*, 2009, pp. 4946–4951.
- [18] X. Yang, W. Yang, H. Zhang, H. Chang, C.-Y. Chen, and S. Zhang, "A new method for robot path planning based artificial potential field," in *2016 IEEE 11th Conference on Industrial Electronics and Applications (ICIEA)*, 2016, no. 2015, pp. 1294–1299.
- [19] G. Li, S. Tong, F. Cong, A. Yamashita, and H. Asama, "Improved artificial potential field-based simultaneous forward search method for robot path planning in complex environment," in *2015 IEEE/SICE International Symposium on System Integration (SII)*, 2015, pp. 760–765.
- [20] T. Weerakoon, K. Ishii, and A. A. F. Nassiraei, "Dead-lock free mobile robot navigation using modified artificial potential field," in *2014 Joint 7th International Conference on Soft Computing and Intelligent Systems (SCIS) and 15th International Symposium on Advanced Intelligent Systems (ISIS)*, 2014, pp. 259–264.
- [21] C. Kao, C. Lin, and J. Juang, "Application of potential field method and optimal path planning to mobile robot control," in *2015 IEEE International Conference on Automation Science and Engineering (CASE)*, 2015, pp. 1552–1554.
- [22] X. Wang, Y. Jin, and Zhaohong Ding, "A path planning algorithm of raster maps based on artificial potential field," in *2015 Chinese Automation Congress (CAC)*, 2015, pp. 627–632.
- [23] Q. Li, L. Wang, B. Chen, and Z. Zhou, "An improved artificial potential field method for solving local minimum problem," in *2011 2nd International Conference on Intelligent Control and Information Processing*, 2011, pp. 420–424.
- [24] G. Masuyama, A. Yamashita, and H. Asama, "Robot motion planning utilizing local propagation of information based on Particle Swarm and its internal parameters," in *2011 IEEE International Conference on Robotics and Biomimetics*, 2011, pp. 1053–1058.



- [25] Xinying Xu, Jun Xie, and Keming Xie, "Path Planning and Obstacle-Avoidance for Soccer Robot Based on Artificial Potential Field and Genetic Algorithm," in *2006 6th World Congress on Intelligent Control and Automation*, 2006, pp. 3494–3498.
- [26] E. F. Mohamed, K. El-Metwally, and A. R. Hanafy, "An improved Tangent Bug method integrated with artificial potential field for multi-robot path planning," in *2011 International Symposium on Innovations in Intelligent Systems and Applications*, 2011, pp. 555–559.
- [27] Mei Wang, Zhiyong Su, Dawei Tu, and Xichang Lu, "A hybrid algorithm based on Artificial Potential Field and BUG for path planning of mobile robot," in *Proceedings of 2013 2nd International Conference on Measurement, Information and Control*, 2013, pp. 1393–1398.
- [28] J. Antich and A. Ortiz, "Bug-based T2: A New Globally Convergent Potential Field Approach to Obstacle Avoidance," in *2006 IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2006, pp. 430–435.
- [29] Na Lv and Zuren Feng, "Numerical Potential Field and Ant Colony Optimization Based Path Planning in Dynamic Environment," in *2006 6th World Congress on Intelligent Control and Automation*, 2006, pp. 8966–8970.
- [30] H. Helble and S. Cameron, "3-D Path Planning and Target Trajectory Prediction for the Oxford Aerial Tracking System," in *Proceedings 2007 IEEE International Conference on Robotics and Automation*, 2007, pp. 1042–1048.
- [31] M. Yuan, Sun'an Wang, J. Zhuang, and K. Li, "Immune Network Algorithm Based on Improved APF for On-Line Dynamic Planning," in *2008 IEEE Conference on Robotics, Automation and Mechatronics*, 2008, pp. 193–198.
- [32] S. Weijun, M. Rui, and Y. Chongchong, "A Study on Soccer Robot Path Planning with Fuzzy Artificial Potential Field," in *2010 International Conference on Computing, Control and Industrial Engineering*, 2010, pp. 386–390.
- [33] A. Melingui, T. Chettibi, R. Merzouki, and J. B. Mbede, "Adaptive navigation of an omni-drive autonomous mobile robot in unstructured dynamic environments," in *2013 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 2013, pp. 1924–1929.
- [34] X. Wang, Y. Liang, J. Hu, and C. Zhao, "Relative angle based obstacle-avoidance," in *2015 34th Chinese Control Conference (CCC)*, 2015, pp. 5491–5496.
- [35] F. Matoui, B. Boussaid, and M. N. Abdelkrim, "Local minimum solution for the potential field method in multiple robot motion planning task," in *2015 16th International Conference on Sciences and Techniques of Automatic Control and Computer Engineering (STA)*, 2015, pp. 452–457.
- [36] Ying-Chun Chen, Huan Qi, and Xia Liu, "Mas-Based Pursuit-Evasion Algorithm Under Unknown Environment," in *2005 International Conference on Machine Learning and Cybernetics*, 2005, pp. 265–269.
- [37] Qian Jia and Xingsong Wang, "An improved potential field method for path planning," in *2010 Chinese Control and Decision Conference*, 2010, pp. 2265–2270.



- [38] J. Lee, Y. Nam, S. Hong, and W. Cho, "New Potential Functions with Random Force Algorithms Using Potential Field Method," *J. Intell. Robot. Syst.*, vol. 66, no. 3, pp. 303–319, May 2012.
- [39] A. A. A. Rizqi, A. I. Cahyadi, and T. B. Adji, "Path planning and formation control via potential function for UAV Quadrotor," in *2014 International Conference on Advanced Robotics and Intelligent Systems (ARIS)*, 2014, pp. 165–170.
- [40] L. Chen, C. Liu, H. Shi, and B. Gao, "New Robot Planning Algorithm Based on Improved Artificial Potential Field," in *2013 Third International Conference on Instrumentation, Measurement, Computer, Communication and Control*, 2013, pp. 228–232.
- [41] H. Bing, L. Gang, G. Jiang, W. Hong, N. Nan, and L. Yan, "A route planning method based on improved artificial potential field algorithm," in *2011 IEEE 3rd International Conference on Communication Software and Networks*, 2011, pp. 550–554.
- [42] S. S. Ge and Y. J. Cui, "New potential functions for mobile robot path planning," *IEEE Trans. Robot. Autom.*, vol. 16, no. 5, pp. 615–620, 2000.
- [43] J. Borenstein and Y. Koren, "Real-time obstacle avoidance for fast mobile robots," *IEEE Trans. Syst. Man. Cybern.*, vol. 19, no. 5, pp. 1179–1187, Sep. 1989.
- [44] Fusheng Tan, Jun Yang, Jianming Huang, Tinggang Jia, Weidong Chen, and Jingchuan Wang, "A navigation system for family indoor monitor mobile robot," in *2010 IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2010, pp. 5978–5983.
- [45] Lei Tang, Songyi Dian, Gangxu Gu, Kunli Zhou, Suihe Wang, and Xinghuan Feng, "A novel potential field method for obstacle avoidance and path planning of mobile robot," in *2010 3rd International Conference on Computer Science and Information Technology*, 2010, pp. 633–637.
- [46] M. G. Park and M. C. Lee, "A new technique to escape local minimum in artificial potential field based path planning," *KSME Int. J.*, vol. 17, no. 12, pp. 1876–1885, Dec. 2003.
- [47] C. Li, G. Cui, and H. Lu, "The design of an obstacle avoiding trajectory in unknown environment using potential fields," in *The 2010 IEEE International Conference on Information and Automation*, 2010, pp. 2050–2054.
- [48] X.-Y. Zou and J. Zhu, "Virtual local target method for avoiding local minimum in potential field based robot navigation," *J. Zhejiang Univ. A*, vol. 4, no. 3, pp. 264–269, May 2003.
- [49] S. Xie, P. Wu, Y. Peng, J. Luo, D. Qu, Q. Li, and J. Gu, "The obstacle avoidance planning of USV based on improved artificial potential field," in *2014 IEEE International Conference on Information and Automation (ICIA)*, 2014, no. 12140500400, pp. 746–751.
- [50] A. A. Masoud, "A decentralized, harmonic, potential field-based controller for steering dynamic agents in a cluttered environment," in *2010 IEEE/ASME International Conference on Advanced Intelligent Mechatronics*, 2010, pp. 503–508.
- [51] A. A. Masoud, "Motion Planning with Gamma-Harmonic Potential Fields," *IEEE Trans. Aerosp. Electron. Syst.*, vol. 48, no. 4, pp. 2786–2801, Oct. 2012.



- [52] E. Freund, "On the design of multi-robot systems," in *Proceedings. 1984 IEEE International Conference on Robotics and Automation*, 1984, vol. 1, pp. 477–490.
- [53] D. L. Brock, D. J. Montana, and A. Z. Ceranowicz, "Coordination and control of multiple autonomous vehicles," in *Proceedings 1992 IEEE International Conference on Robotics and Automation*, 1992, pp. 2725–2730.
- [54] H. Kitano, S. Tadokoro, and K. Osuka, "RoboCup Rescue project: challenges and benchmark," in *Proceedings. 2000 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2000) (Cat. No.00CH37113)*, 2000, pp. 1886–1893.
- [55] C. W. Warren, "Global path planning using artificial potential fields," in *Proceedings, 1989 International Conference on Robotics and Automation*, 1989, pp. 316–321.
- [56] J. Borenstein and Y. Koren, "High-speed obstacle avoidance for mobile robots," in *Proceedings IEEE International Symposium on Intelligent Control 1988*, 1988, pp. 382–384.
- [57] J.-O. Kim and P. K. Khosla, "Real-time obstacle avoidance using harmonic potential functions," *IEEE Trans. Robot. Autom.*, vol. 8, no. 3, pp. 338–349, Jun. 1992.
- [58] R. Spence and S. Hutchinson, "Dealing With Unexpected Moving Obstacles By Integrating Potential Field Planning With Inverse Dynamics Control," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems*, 1992, vol. 3, pp. 1485–1490.
- [59] S. Sundar and Z. Shiller, "Optimal obstacle avoidance based on the Hamilton-Jacobi-Bellman equation," in *Proceedings of the 1994 IEEE International Conference on Robotics and Automation*, 1994, pp. 2424–2429.
- [60] G. Dozier, A. Homaifar, S. Bryson, and L. Moore, "Artificial potential field based robot navigation, dynamic constrained optimization and simple genetic hill-climbing," in *1998 IEEE International Conference on Evolutionary Computation Proceedings. IEEE World Congress on Computational Intelligence (Cat. No.98TH8360)*, 1998, pp. 189–194.
- [61] H. Noborio, S. Wazumi, S. Fukuda, and S. Arimoto, "A Potential Approach For A Point Mobile Robot On An Implicit Potential Field Without The Generation Of Local Minima," in *Proceedings. IEEE/RSJ International Workshop on Intelligent Robots and Systems '89 (IROS '89) 'The Autonomous Mobile Robots and Its Applications*, 1989, pp. 70–77.
- [62] Liu Chengqing, M. H. Ang, H. Krishnan, and Lim Ser Yong, "Virtual obstacle concept for local-minimum-recovery in potential-field based navigation," in *Proceedings 2000 ICRA. Millennium Conference. IEEE International Conference on Robotics and Automation. Symposia Proceedings (Cat. No.00CH37065)*, 2000, pp. 983–988.
- [63] Min Cheol Lee and Min Gyu Park, "Artificial potential field based path planning for mobile robots using a virtual obstacle concept," in *Proceedings 2003 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2003)*, 2003, pp. 735–740.
- [64] Ding Fu-guang, Jiao Peng, Bian Xin-qian, and Wang Hong-jian, "AUV local path planning based on virtual potential field," in *IEEE International Conference Mechatronics and Automation*, 2005, 2005, vol. 4, pp. 1711–1716.



- [65] Min Gyu Park and Min Cheol Lee, "Real-time path planning in unknown environment and a virtual hill concept to escape local minima," in *30th Annual Conference of IEEE Industrial Electronics Society, 2004. IECON 2004*, 2004, vol. 3, pp. 2223–2228.
- [66] S. Ping, L. Kejie, H. Xiaobing, and Q. Guangping, "Formation and obstacle-avoidance control for mobile swarm robots based on artificial potential field," in *2009 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 2009, pp. 2273–2277.
- [67] Xiaoping Yun and Ko-Cheng Tan, "A wall-following method for escaping local minima in potential field based motion planning," in *1997 8th International Conference on Advanced Robotics. Proceedings. ICAR'97*, 1997, pp. 421–426.
- [68] C. Qixin, H. Yanwen, and Z. Jingliang, "An Evolutionary Artificial Potential Field Algorithm for Dynamic Path Planning of Mobile Robot," in *2006 IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2006, pp. 3331–3336.
- [69] Y. Zhu, T. Zhang, and J. Song, "An improved wall following method for escaping from local minimum in artificial potential field based path planning," in *Proceedings of the 48th IEEE Conference on Decision and Control (CDC) held jointly with 2009 28th Chinese Control Conference*, 2009, pp. 6017–6022.
- [70] J. Sfeir, M. Saad, and H. Saliah-Hassane, "An improved Artificial Potential Field approach to real-time mobile robot path planning in an unknown environment," in *2011 IEEE International Symposium on Robotic and Sensors Environments (ROSE)*, 2011, pp. 208–213.
- [71] Hongyan Shi, Changzhi Sun, Xiaoming Sun, and Ting Feng, "Chaotic Potential Field Method and Application in Robot Soccer Game," in *2006 6th World Congress on Intelligent Control and Automation*, 2006, pp. 9297–9301.
- [72] J. Barraquand, B. Langlois, and J.-C. Latombe, "Numerical potential field techniques for robot path planning," *IEEE Trans. Syst. Man. Cybern.*, vol. 22, no. 2, pp. 224–241, 1992.
- [73] K. A. Mclsaac, Jing Ren, and Xishi Huang, "Modifed newton's method applied to potential field navigation," in *42nd IEEE International Conference on Decision and Control (IEEE Cat. No.03CH37475)*, 2003, vol. 6, pp. 5873–5878.
- [74] C. I. Connolly, J. B. Burns, and R. Weiss, "Path planning using Laplace's equation," in *Proceedings., IEEE International Conference on Robotics and Automation*, 1990, pp. 2102–2106.
- [75] X. Tan and D. Chen, "A Hybrid Approach of Path Planning for Mobile Robots Based on the Combination of ACO and APF Algorithms," in *2009 International Workshop on Intelligent Systems and Applications*, 2009, pp. 1–4.
- [76] M. A. K. Jaradat, M. H. Garibeh, and E. A. Feilat, "Autonomous mobile robot dynamic motion planning using hybrid fuzzy potential field," *Soft Comput.*, vol. 16, no. 1, pp. 153–164, Jan. 2012.





- [77] M. Soucy and P. Payeur, "Flexible fuzzy logic control for collision-free manipulator operation," in *IEEE International Conference Mechatronics and Automation, 2005*, 2005, vol. 2, pp. 723–728.
- [78] R. Iraj and M. T. Manzuri-Shalmani, "A New Fuzzy-Based Spatial Model for Robot Navigation among Dynamic Obstacles," in *2007 IEEE International Conference on Control and Automation*, 2007, pp. 1323–1328.
- [79] Q. Li, C. Zhang, C. Han, Y. Xu, Y. Yin, and W. Zhang, "Path planning based on fuzzy logic algorithm for mobile robots in static environment," in *2013 25th Chinese Control and Decision Conference (CCDC)*, 2013, pp. 2866–2871.
- [80] Y. Cen, L. Wang, and H. Zhang, "Real-time Obstacle Avoidance Strategy for Mobile Robot Based On Improved Coordinating Potential Field with Genetic Algorithm," in *2007 IEEE International Conference on Control Applications*, 2007, pp. 415–419.
- [81] Wang Wei, Guo Cunsheng, and Wei Shimin, "3-D path planning for a mobile robot," in *2010 8th World Congress on Intelligent Control and Automation*, 2010, pp. 756–760.
- [82] E. S. Plumer, "Neural network structure for navigation using potential fields," in *[Proceedings 1992] IJCNN International Joint Conference on Neural Networks*, 1992, vol. 1, pp. 327–332.
- [83] D. Yag, J. Ren, and R. Liscano, "Motion planning for multi-link robots using Artificial Potential Fields and modified Simulated Annealing," in *Proceedings of 2010 IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications*, 2010, pp. 421–427.
- [84] A. Nooraliei and A. A. Altun, "Temperature Determination in Simulated Annealing Using Learning Automata," in *2009 Second International Conference on Computer and Electrical Engineering*, 2009, pp. 114–117.
- [85] Yan Yongjie and Zhang Yan, "Collision avoidance planning in multi-robot based on improved artificial potential field and rules," in *2008 IEEE International Conference on Robotics and Biomimetics*, 2009, pp. 1026–1031.
- [86] S. Charifa and M. Bikdash, "Adaptive boundary-following algorithm guided by artificial potential field for robot navigation," in *2009 IEEE Workshop on Robotic Intelligence in Informationally Structured Space*, 2009, pp. 38–45.
- [87] J. Ren, K. A. Mclsaac, R. V. Patel, and T. M. Peters, "A Potential Field Model Using Generalized Sigmoid Functions," *IEEE Trans. Syst. Man Cybern. Part B*, vol. 37, no. 2, pp. 477–484, Apr. 2007.
- [88] S. Hassan and Jungown Yoon, "Smart Targeted Drug Delivery System Using Swarm Based Drug Loaded Nano Particles Simulation," in *2013 4th International Conference on Intelligent Systems, Modelling and Simulation*, 2013, pp. 177–181.
- [89] Z. Su, B. Zeng, G. Liu, F. Ye, and M. Xu, "Application of Fuzzy Neural Network in Parameter Optimization of Mobile Robot Path Planning Using Potential Field," in *2007 IEEE International Symposium on Industrial Electronics*, 2007, pp. 2125–2128.



- [90] B. Zeng, Y.-M. Yang, and Z.-W. Su, "A self-organizing environmental potential field model based on fuzzy neural networks," in *2008 International Conference on Machine Learning and Cybernetics*, 2008, pp. 1835–1839.
- [91] J. Bosco Mbede, Xinhan Huang, and Min Wang, "Robust neuro-fuzzy sensor-based motion control among dynamic obstacles for robot manipulators," *IEEE Trans. Fuzzy Syst.*, vol. 11, no. 2, pp. 249–261, Apr. 2003.
- [92] L. C. Gonzalez-Sua, O. Barron, R. Soto, L. Garrido, I. Gonzalez, J. L. Gordillo, and A. Garza, "Design and Implementation of a Fuzzy-Based Gain Scheduling Obstacle Avoidance Algorithm," in *2013 12th Mexican International Conference on Artificial Intelligence*, 2013, pp. 45–49.
- [93] Kong Feng, Xie Chaoping, and Wang Zijian, "Appication of a mixed method in bio-fish path planning," in *2010 2nd International Conference on Education Technology and Computer*, 2010, pp. V5–17–V5–19.
- [94] S. Bouabdallah, P. Murrieri, and R. Siegwart, "Design and control of an indoor micro quadrotor," in *IEEE International Conference on Robotics and Automation, 2004. Proceedings. ICRA '04. 2004*, 2004, pp. 4393–4398 Vol.5.
- [95] R. Mahony, V. Kumar, and P. Corke, "Multirotor Aerial Vehicles: Modeling, Estimation, and Control of Quadrotor," *IEEE Robot. Autom. Mag.*, vol. 19, no. 3, pp. 20–32, Sep. 2012.
- [96] J. Ajmera and V. Sankaranarayanan, "Point-to-Point Control of a Quadrotor: Theory and Experiment," *IFAC-PapersOnLine*, vol. 49, no. 1, pp. 401–406, 2016.
- [97] F. Belkhouche, B. Belkhouche, and P. Rastgoufard, "Line of sight robot navigation toward a moving goal," *IEEE Trans. Syst. Man, Cybern. Part B Cybern.*, vol. 36, no. 2, pp. 255–267, 2006.
- [98] J. P. Desai, J. Ostrowski, and V. Kumar, "Controlling formations of multiple mobile robots," in *Proceedings. 1998 IEEE International Conference on Robotics and Automation (Cat. No.98CH36146)*, 1998, vol. 4, pp. 2864–2869.