

A Localization Parameter Estimation Model for CKN-based Wireless Sensor Networks

Yuan-Fang Chen^{1, *}, Ming-Chu Li¹, and Xue-Chao Cheng²

¹ Department of Software,
Dalian University of Technology,
DaLian 116024, China
yuanfang_chen@ieee.org, mingchul@dlut.edu.cn

² Hangzhou Dianzi University,
Zhejiang 310018, China
xuechao.cheng@gmail.com

Received 15 September 2011; Revised 25 October 2011; Accepted 15 December 2011

Abstract. Location information of nodes is the basis for many applications in wireless sensor networks (WSNs). However, most previous localization methods make the unrealistic assumption: all nodes in WSN are always awake. This overlooks the common scenario that sensor nodes are duty-cycled to save energy. In this paper we propose a model about localization parameters estimation (LPEM), based on duty-cycled nodes. The model solve: How is the relationship between the parameters (i.e., transmission radius (r), critical neighbor number (k) and the number of nodes (n)) in duty-cycle-based network? And we can use this model to estimate any parameter when the other parameters are known. We conduct a large number of experiments in WSNs simulator Matlab, and find that the parameters are interactional. Moreover, using our model can get the parameters configuration to achieve near-optimal localization accuracy while we run localization algorithm.

Keywords: Localization parameters, estimation model, dynamic parameter estimation, wireless sensor networks

References

- [1] C.C. Chang, I.C. Lin, C.C. Lin, "A Novel Location Tracking Scheme for Reducing Location Updating Traffic in a Personal Communication System," *Wireless Personal Communications*, Vol. 44, No. 2, pp. 139-152, 2008.
- [2] T. Yan, T. He, J. A. Stankovic, "Differentiated Surveillance Service for Sensor Networks," in *Proceeding of First ACM Conference on Embedded Networked Sensor Systems*, Los Angeles, CA, USA, pp. 51-62, 2003.
- [3] J. Li, J. Jannotti, D. S. J. De Couto, D. Karger, R. Morris, "A Scalable Location Service for Geographic Ad-Hoc Routing," in *Proceedings of the 6th Annual International Conference on Mobile Computing and Networking*, Boston, Massachusetts, USA, pp. 56-67, 2000.
- [4] P. Bahl and V. Padmanabhan, "RADAR: An In-building RF-based User Location and Tracking system," in *Proceedings of 2000 Nineteenth Annual Joint Conference of the IEEE Computer and Communications Societies*, Tel Aviv, Israel, pp. 775-784, 2000.
- [5] A. Harter, A. Hopper, P. Steggle, A. Ward, P. Webster, "The Anatomy of a Context-aware Application," *Wireless Networks*, Vol. 8, No. 2/3, pp. 187-197, 2002.
- [6] N. Priyantha, A. Chakraborty, H. Balakrishnan, "The Cricket Location Support System," in *Proceedings of the 6th Annual International Conference on Mobile Computing and Networking*, Boston, Massachusetts, USA, pp. 32-43, 2000.

*Correspondence author

- [7] D. Niculescu and B. Nath, "DV Based Positioning in Ad hoc Networks," *Telecommunication Systems*, Vol. 22, No. 1-4, pp. 267-280, 2003.
- [8] J. Hightower, G. Boriello, R. Want, "SpotON: An Indoor 3D Location Sensing Technology Based on RF Signal Strength," *University of Washington CSE Report #2000-02-02*, 2000.
- [9] B. H. Wellenhof, H. Lichtenegger, J. Collins, "Global Positioning System," *Theory and Practice*, Springer Verlag, 1997.
- [10] A. Savvides, C. Han, M. Strivastava, "Dynamic Fine-grained Localization in Ad-hoc Networks of Sensors," in *Proceedings of the 7th Annual International Conference on Mobile Computing and Networking*, Rome, Italy, pp. 166-179, 2001.
- [11] D. Niculescu and B. Nath, "Ad hoc Positioning System (APS) Using AOA," in *Proceedings of The 22nd Annual Joint Conference of the IEEE Computer and Communications Societies*, San Francisco, CA, USA, pp. 1734-1743, 2003.
- [12] C. Savarese, J. Rabay, K. Langendoen, "Robust Positioning Algorithms for Distributed Ad-Hoc Wireless Sensor Networks," in *Proceedings of the General Track: 2002 USENIX Annual Technical Conference*, Monterey, CA, USA, pp.317-327, 2002.
- [13] A. Savvides, H. Park, M. Srivastava, "The Bits and Flops of the N-Hop Multilateration Primitive for Node Localization Problems," in *Proceedings of the First ACM International Workshop on Wireless Sensor Networks and Applications*, Atlanta, Georgia, USA, pp. 112-121, 2002.
- [14] K. Whitehouse and D. Culler, "Calibration as Parameter Estimation in Sensor Networks," in *Proceedings of the First ACM International Workshop on Wireless Sensor Networks and Applications*, Atlanta, Georgia, USA, pp. 59-67, 2002.
- [15] T. He, C. Huang, B. M. Blum, J. A. Stankovic, T. F. Abdelzaher, "Range-free Localization Schemes for Large Scale Sensor Networks," in *Proceedings of the Ninth Annual International Conference on Mobile Computing and Networking*, San Diego, CA, USA, pp. 81-95, 2003.
- [16] Z. Yan, Y. Chang, Z. Shen, Y. Zhang, "A Grid-Scan Localization Algorithm for Wireless Sensor Network," in *Proceedings of IEEE International Conference on Communications and Mobile Computing*, Kunming, Yunnan, China, pp. 142-146, 2009.
- [17] Y. Shang, W. Ruml, Y. Zhang, M. Fromherz, "Localization from Mere Connectivity," in *Proceedings of the 4th ACM International Symposium on Mobile Ad Hoc Networking and Computing*, Annapolis, MD, USA, pp. 201-212, 2003.
- [18] S. Simic and S. Sastry, "Distributed Localization in Wireless Ad hoc Networks," *UC Berkeley ERL report*, 2002.
- [19] S. Nath and P. Gibbons, "Communicating via Fireflies: Geographic Routing on Duty-cycled Sensors," in *Proceedings of the 6th International Conference on Information Processing in Sensor Networks*, Cambridge, Massachusetts, USA , pp. 440-449, 2007.
- [20] F. Sun and M. Shayman, "On the Average Pair-wise Connectivity of Wireless Multi-hop Networks," in *Proceedings of Global Telecommunications Conference*, Louis, Missouri, USA, pp. 1762-1766, 2005.
- [21] P.J. Wan and C.W. Yi, "Asymptotic Critical Transmission Radius and Critical Neighbor Number for k-Connectivity in Wireless Ad Hoc Networks," in *Proceedings of the 5th ACM international symposium on Mobile ad hoc Networking and Computing*, Tokyo, Japan, pp. 1-8, 2004.
- [22] M. D. Penrose, "On k-connectivity for a Geometric Random Graph," *Random Structures Alg.*, Vol. 15, No. 3, pp. 145-164, 1999.