IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 2, February 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.488

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 2, February 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0902024 |

Ingenious Wireless Sensor Network Applications Using Advanced Data Fusion Techniques

P.Senthil Kumaran [*1], N.Jayanthi[*2], Dr.D.Chitra[*3]

PG Student, M.E(Communication Systems), Mahendra Engineering College, Namakkal, TamilNadu, India[*1]

ECE(PG), Mahendra Engineering College, Namakkal, TamilNadu, India[*2,*3]

ABSTRACT: Wireless sensor networks have been used for critical applications such as security surveillance and environmental monitoring. Although many advanced collaborative signal processing algorithm have been adopted by many WSNs, previously analytical studies on sensing coverage are conducted based on overly simplistic sensing models (e.g., Disc model) that do not capture the random nature of sensing. In this chapter we attempt to bridge this gap by exploring the fundamental limits of coverage based on stochastic data fusion that fuse noisy measurements of multiple sensors. We derive the scaling laws between the coverage, network density, and signal to noise ratio (SNR). We show that data fusion data fusion can significantly improve sensing coverage by exploiting the collaboration among sensors when different properties of the target signals are known. For regularly deployed networks we show that data fusion can also reduce network density and mobile networks where mobile sensors can relocate to fill coverage holes. Previous analytical results based on the disc model have some limitations our result helps to understand and provide key insights into the design of WSNs that adopt data fusion algorithms.

KEYWORDS: Coverage, mobility, data fusion, target detection, performance limits, wireless sensor network (WSN).

I.INTRODUCTION

Recent years have made the deployments of wireless sensor networks (WSNs) for many of the critical applications such as environmental monitoring [2], security surveillance [1] and target detection/tracking [3]. Many of these applications involve a large number of sensors distributed in a vast geographical area. As a result, the cost of deploying these networks into the physical environment is high. A key challenge is thus to predict and understand the expected sensing performance of these WSNs. A fundamental performance measure of WSNs that characterizes how well a sensing field is monitored i.e. sensing coverage of a network. Many recent studies are focused on analyzing the coverage performance of large-scale Wireless Sensor Network. Any WSN applications are designed based on The sensing performance of a network is improved by jointly processing the noisy measurements of multiple sensors by Collaborative signal processing algorithm.

Various random data fusionschemes have been employed by sensor network systems for detection, event monitoring, localization, and classification. Collaborative signal processing algorithms such as data fusion will have complex complications sensing performance to the network-level such as coverage. As a result, most analytical studies on sensing coverage are conducted based onsimplisticsensing models [8]–[10], [4], [21]–[17]. In particular, the sensing region of a sensor is often modeled as a disc with radius r centered at the position of the sensor, where r is referred to as the sensing range. Sensors deterministically detect the targets (actions) inside its sensing range. Although such a representation allows a statistical behavior to the coverage problem, it will not capture the stochastic nature of sensing.

To illustrate the factual error of the disc sensing form, we plot the sensing performance of an sound sensor using the data traces collectively from a real vehicle detection experiment [11]. In the experiment, the sensor detects moving vehicles by comparing its signal energy measurement against a threshold (denoted by t). The probability that the sensor detects a vehicle (denoted by Pd) versus the distance from the vehicle. No clear cutoff limit between effective and ineffective sensing of the target. A similar result is observed for the relationship between the sensor's false alarm rate (denoted by Pf) and the detection threshold. Note that is the probability of making a positive decision when novehicle is present.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |
|| Volume 9, Issue 2, February 2021 ||
| DOI: 10.15680/IJIRCCE.2021.0902024 |

The key focus of this thesis is to investigate the fundamental scaling laws between coverage, signal-to noise ratio (SNR) and network density. To the best of our knowledge, this work is the first to study the coverage performance of large-scale WSNs based on collaborative sensing models. Our results not only help understand the limitations of the existing analytical results based on the disc model, but also provide key insights into designing and analyzing the large-scale WSNs that adopt stochastic fusion algorithms. The main assistance of this paper are as follows.

• We derive the coverage of random network under both data fusion and probabilistic disc models. The existing analytical results based on the typical disc model can be naturally extensive to the context of stochastic event detection. With these results, we can compute the minimum network density before the deployment or turn on the smallest amount sensors of an existing network to achieve a desired level of sensing coverage.

• The impact of SNR on the network density when full coverage is required. This result suggest that data fusion is more efficient in reducing the density of low-SNR network deployments, while the disc model is suitable only when the SNR is satisfactorily high.

• Besides static networks, we also learn the coverage performance of mobile networks, in which mobile sensors displace themselves to fill coverage holes after the initial deployment. We extend a relocation approach that is based on the disc model [18] to the data fusion model. We show that data fusion results in lower network density without rising the moving distance of mobile sensors.

• To verify our analyses, we carry out extensive simulations based on both artificial data sets and actual data traces collected from 20 sensors. The simulation results validate our analytical results under a variety of practical settings.

II. PROJECT DESCRIPTION

Many sensor network systems have included various data fusion schemes to progress the system performance. In the surveillance system based on MICA2 motes [1], the system false alarm rate is condensed by fusing the detection decisions made by several sensors. In the DARPA SensIT project [11], advanced data fusion techniques have been employed in a number of algorithms and protocols designed for target detection [3], [12], localization and classification [11], [12]. Despite the wide adoption of data fusion in practice, the performance analysis of large-scale fusion-based WSNs has received little concentration. There is vast literature on stochastic signal detection based on multisensordata fusion. Early works focus on small-scale powerful sensor networks (e.g., several radars). The theories on decentralized detection are surveyed already. Recent studies on data fusion have considered the exact properties of WSNs such as sensors' spatial allocation [11], [12], limited sensing/communication capability, and sensor breakdown]. However, these studies focus on analyzing the optimal fusion strategy that maximize the system performance

As one of the most basic issues in WSNs, the coverage problem has involved significant research attention. Previous works fall into two categories—namely, coverage maintenance algorithms/protocol and speculative analysis of coverage performance. These two categories are reviewed briefly as follows, respectively. Early work] quantify sensing coverage by theLength of target's path where the accumulative observations of sensors are maximum or minimum. However, these works focus on devising algorithms for finding the target's paths with definite level of coverage. Several algorithms and protocols [9] are designed to keep sensing coverage using the minimum number of sensors. However, the efficiency of these schemes largely relies on the statement that sensors have spherical sensing regions and deterministic sensing Capability. Several recent studies on the coverage problem have adopted probabilistic sensing models. The mathematical results in [10] show that the coverage of a network can be expanded by the support of sensors through data fusion. However, these studies do not quantify the enhancement of coverage due to data fusion techniques. Different from our focus on analyzing the basic limits of coverage in WSNs, all of these studies aim to devise algorithms and protocols for coverage maintenance.

A. *Sensor Measurement and Network Models*

We assume that sensors perform detection by measuring the energy of signals emitted by the target.2 the energy of most substantial signals (e.g., acoustic and electromagnetic signals) attenuates with the space from the signal source. Suppose sensor is meters away from the object that emits a signal of energy.

The sensor measurements are contaminated by additive unsystematic noises from sensor hardware or environment. Depending on the suggestion that the target is absent (H0) or present (H1), the measurement of sensor i , denoted by y_i , is given by

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 2, February 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0902024 |

H0 :yi = ni   H1 : yi = si + ni

where is the energy of noise experience by sensor . We assume that the noise ni at each sensor follows the normal distribution.

We consider two consumption schemes, i.e., random andregularnetworks. In the random networks, the positions of sensors are uniformly and independently distributed in the region. Such a deployment scenario can be modeled as a stationary two-dimensional Poisson point process. Let denote the density of the underlying Poisson point process.

B. *Data Fusion Model*

Data fusion can improve the performance of finding systems by jointly taking into account the noisy measurements of several sensors. There exist two basic data fusion schemes—namely, decision fusion and value fusion. In decision fusion, each sensor makes a local decision based on its capacity and sends its decision to the cluster head, which makes a system decision according to the local decisions. The best decision fusion rule has been obtained in [12]. In value fusion, each sensor sends its measurements to the cluster head, which makes the finding decision based on the received measurements. In this document, we focus on value fusion, as it usually has better detection performance than decision fusion. A practical solution is to adopt equal constant weights for all sensors' measurements. The measurements from different sensors are treated in the same way, the sensors faraway from the target should be expelled from data fusion as their measurements suffer low SNRs.

The coverage of mobile phone WSNs with random sensor mobility have been studied based on the disc model in [36]. In this paper, we focus on quantifying the enhancement of coverage in the mobile network with limited sensor mobility due to data fusion.

III. BACKGROUND AND PROBLEM DEFINITION

Sensors are deployed in a vast two-dimensional geographical region.We consider two deployment schemes, i.e., *random* and *regular* networks. In the random networks, the positions of sensors are uniformly and independently distributed in the region. Such a deployment scenario can be modeled as a stationarytwo-dimensional Poisson point process. Let denote thedensity of the underlying Poisson point process.

IV. CONCLUSION

The sensor measurements from different sensors are fused and have to make decision by value fusion method. The dynamic clustering algorithm will be implemented, a cluster formed by the sensors within the fusion range from the possible target to make a detection decision. The optimal fusion range that maximizes the coverage of regular network will increases with network density.

REFERENCES

[1] Rui Tan, Guoliang Xing, Benyuan Liu, Jianping Wang, and XiaohuaJia, "Exploiting Data Fusion to Improve the Coverage of Wireless Sensor Networks," in IEEE/ACM Transactions On Networking, Vol. 20, No. 2, April 2012

[2] T. He, S. Krishnamurthy, J. A. Stankovic, T. Abdelzaher, L. Luo, R. Stoleru, T. Yan, L. Gu, J. Hui, and B. Krogh, "Energy-efficient surveillance system using wireless sensor Networks," in Proc. MobiSys, , pp. 270–283, 2004.

[3] A. Mainwaring, D. Culler, J. Polastre, R. Szewczyk, and J. Anderson, "Wireless sensor networks for habitat monitoring," in Proc. ACM WSNA, pp. 88–97, 2002.

[4] D. Li, K. Wong, Y. H. Hu, and A. Sayeed, "Detection, classification and tracking of targets," IEEE Signal Process. Mag., vol. 19, no. 2, pp.17–29, Mar. 2002.

[5] P.-J. Wan and C.-W. Yi, "Coverage by randomly deployed wireless sensor networks," IEEE Trans. Inf. Theory, vol. 52, no. 6, pp. 2658–2669, Jun. 2006.

[6] S. Shakkottai, R. Srikant, and N. Shroff, "Unreliable sensor grids: Coverage, connectivity and diameter," in Proc. IEEE INFOCOM, pp.1073–1083, 2003.

[7] Z. Chair and P. Varshney, "Optimal data fusion in multiple sensor detection systems," IEEE Trans. Aerosp. Electron. Syst., vol. AES-22, no 1, pp. 98–101, Jan. 1986.

[8] M. Duarte and Y. H. Hu, "Vehicle classification in distributed sensor networks," J. Parallel Distrib. Comput., vol. 64, no. 7, pp. 826–838,2004. 24

[9] W.-P. Chen, J. C. Hou, and L. Sha, "Dynamic clustering for acoustic target tracking in wireless sensor networks," IEEE Trans. Mobile Comput., vol. 3, no. 3, pp. 258–271, Mar. 2004.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 2, February 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0902024 |

[10] S. Chellappan, W. Gu, X. Bai, D. Xuan, B. Ma, and K. Zhang, "Deployingwireless sensor networks under limited mobility constraints," IEEE Trans. Mobile Comput., vol. 6, no. 10, pp. 1142–1157, Oct. 2007.
[11] N. Bisnik, A. Abouzeid, and V. Isler, "Stochastic event capture using mobile sensors subject to a quality metric," in Proc. ACM MobiCom, 2006, pp. 676–692.
[12] D. Li, K. Wong, Y. H. Hu, and A. Sayeed, "Detection, classification and tracking of targets," IEEE Signal Process. Mag., vol. 19, no. 2, pp. 17–29, Mar. 2002.