International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)
ISSN: 0976-1353 Volume 24 Issue 9 – JUNE 2017.

Scheduling Collision Free Packet in Underwater Acoustic Sensor Network Using Localization

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***Abstract*— In underwater acoustic sensor network [UASN], sensors life time increment is the main problem, manually we cannot recharge the battery by going deep into the sea or ocean and we cannot recharge it by solar power since sun light won't go deep into the sea. In previous work on UASN they considers only static network, but in this paper we consider dynamic network (changes by time, either the sensor is active, malfunctioned, dead or lost) and in previous work they took 2D model and in this we consider a 3D model for sensing the target. To improve the life time of Underwater Acoustic Sensor Network (UASN) we developed a Heuristic Search Algorithm (Multi-population Harmony Search Algorithm) to dynamically choose to sleep or work a given set of sensors in order to cover the given set of targets.**

***Index Terms*— Underwater acoustic sensor network, harmony search algorithm, multi-population, dynamic optimization, pitch adjusting rate.**

I. INTRODUCTION

Underwater acoustic communication is a technique of sending and receiving messages below water.There are several ways of employing such communication but the most common is by using hydrophones. Underwater communication is difficult due to factors such as multi-path propagation, time variations of the channel, small available bandwidth and strong signal attenuation, especially over long ranges. Compared to terrestrial communication, underwater communication has low data rates because it uses acoustic wavesinstead of electromagnetic waves.

I. In general the modulation methods developed for radio communications can be adapted for underwater acoustic communications (UAC). However some of the modulation schemes are more suited to the unique underwater acoustic communication channel than others. Some of the modulation methods used for:

- Frequency Shift Keying (FSK)
- Phase Shift Keying (PSK)
- Frequency Hopped Spread Spectrum (FHSS)
- Direct Sequence Spread Spectrum (DSSS)
- Frequency and Pulse-position modulation (FPPM and PPM)
- Multiple Frequency Shift Keying (MFSK)

Orthogonal Frequency-Division Multiplexing (OFDM)

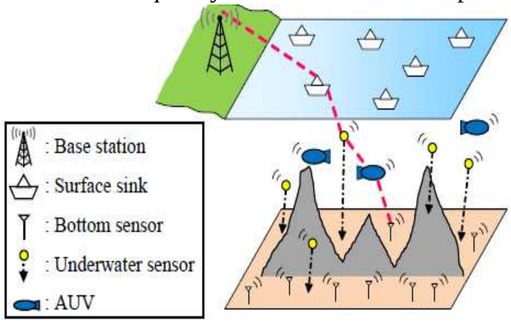

Fig: 1 Illustration of underwater acoustic sensor networks.

II. UASN

Acoustic communication is used to transmit signals in underwater. In fact, radio wave will transmit more than acoustic but in sea water it requires big antennas and high transmitting rate. Optical waves do not support such high transmission rate.

A. CHALLENGES OF UASN

• Limited bandwidth.
• Impaired channel.
• High Propagation delay.
• Bit error rate is high.
• Limited battery power.
• Failure ofsensors due to fouling and corrosion.

B. APPLICATIONS OF UASN

Ocean sampling networks, undersea explorations, Mine reconnaissance, distributed tactical surveillance, Environmental monitoring, Disaster prevention, assisted navigation.

III. CONTRIBUTION OF THE PRESENT WORK

First, this work considers a dynamic problem. Second, positions of some sensors are not fixed the proposed algorithm can dynamically apply the updated positions to make a new sleep schedule.

A. BASIC HARMONY SEARCH ALGORITHM

B. Musicians play many harmonies, for various combination of music. Harmony search has two different functions they are ***Harmony Memory considering Rate (HMCR) and Pitch Adjusting Rate (PAR).***

Rules for better harmony in music:
1. Selecting any pitch from memory.
2. Selecting adjacent pitch.
3. Selecting any random pitch.

Similar rules for sensor targeting:
1. Selecting any value.
2. Selecting adjacent value.
3. Selecting any random value.

In Fig:2 it shows the block diagram of harmony search algorithm and how it works based upon the above rules.

IV. THE PROPOSED METHOD MPHSA

When compared to genetic algorithm, MPHSA is more advanced. HSA is used mainly for dynamic model.

A. 3D MODEL

Fig: 3 shows the three dimensional representation of underwater sensor networks. In 3D underwater networks, sensors are allowed to float in water. The sensors are tied with a wire so that the height can be adjusted according to the target.

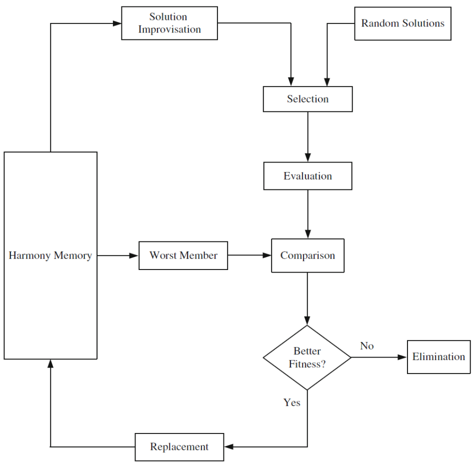

Fig: 2 Harmony Search Algorithm

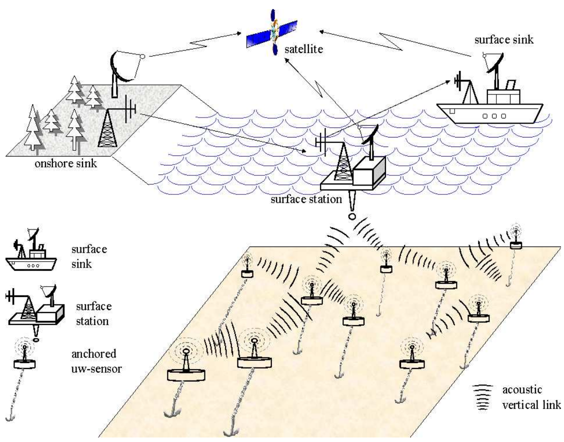

Fig: 3 Three-Dimensional representation of UASN

V. MATHEMATICAL MODEL

Consider in Fig. 4(a), there are 6 number of sensors (s_1–s_6) and 4 number of target(π_1–π_4). Each sensor is arranged in a sphere structure to cover all targets easily. The sensing range size of each sensor may differ due to its heterogeneous sensor type. Base station (BS) is placed, up above the sea level to collect the messages which is transmitted from the sea bed.

At a particular time, each sensor could be in one of four modes: active, asleep, malfunctioned, and dead. Only active sensors will work to detect the targets and consume battery power.To save the battery power, sensors that are not active can be turned off. Sensor may be dead due to battery power depletion, or get lost due to external factors.

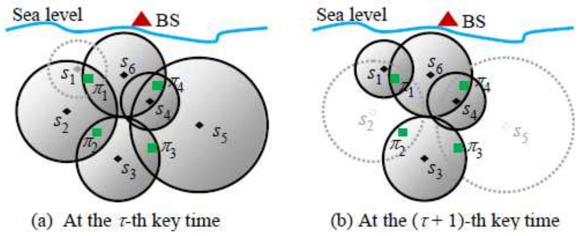

Fig: 4 Example for dynamic UASN at two key times.

Sensors that are active or asleep are called as surviving sensors and sensors that are malfunctioned or deadlines are called to fail.

Sensor modes vary, based upon the active sensors vary at each and every time. So, in this work we propose a method to decide a sleep schedule at each and every key time.

As shown in Fig. 5, the 1st key time is the initial time, at which each sensor is works with the initial battery power. Here the sleep schedule is initialised. During the 1st key if some targets are not covered mean the 2nd key time is started.

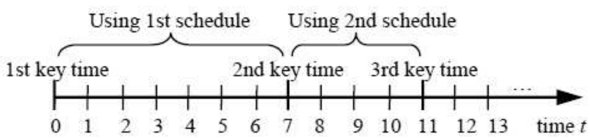

Fig: 5 Relationship between sleep schedule and key time.

At the 2nd key time, the sensors information is updated and sleep schedule is followed to cover all targets.

Similarly, the 3rd key time, 4th key time and so on can be followed. And, a sleep schedule is followed at each key time until survival sensors cannot cover all targets.

VI. NOTATIONS USED

S : Set of Sensors, S={$s_1, s_2, \ldots, s_n$ }

T : Set of Targets, T={π1, π2,…n}

S_τ: Set of survival sensors at the τ-th key time

F_τ: Set of malfunctioned sensors at the τ -th key time

D_τ: Set of dead sensors at the τ -th key time.

R_τ: Set of sensors that are recovered at the τ -th key time.

P_f : Malfunction probability

P_d : Dead probability

P_r : Recovery probability

S = {$s_1, s_2, \ldots, s_n$} in a UASN to detect all targets in T = {$\pi_1, \pi_2, \ldots, \pi_m$} at different key times. Consider the sleep schedule at the τ-th key time. Initially update the set of survival sensors(Sτ) at τ-th key time.

Sτ = (Sτ -1 U Rτ) \ (Fτ ∩ Dτ)

VII. MPHSA ALGORITHM

1. At the τ-th key time survival sensors are updated
2. Initialize the parent harmony memory HM.
3. Divide HM into sub-HM (sub-HM1, sub-HM2, …, sub-HMδ)
4. Initialize the current iteration number as 1(ie., η=1,2,….,n)
5. **if** rand(0, 1) <HMCR **then**
6. Choose two harmonies x^{new1} and x^{new2} from sub-HMi
7. **if** rand(0, 1) <PAR(η) **then**
8. Make a uniform crossover operator on x^{new1} and x^{new2}, and replacethe resultant value in te place of $x^{new1}$and x^{new2}.
9. **end if**
10. Let x^{new} be the one of x^{new1} and x^{new2} with a better fitness value
11. **else**
12. Randomly generate a feasible harmony as x^{new}
13. **end if**
14. If x^{new} is better than worst harmony in sub-HMi, x^{new} replaces it
15. **end for**
16. η = η + 1
17. **end while**
18. Decode the best harmony among all sub-HMi's
19. If number of covers is non zero, randomly choose one of the covers as the output, otherwise output is zero i.e., no solution.

VIII. SIMULATION RESULT

By using different number of sensors and targetswe can run the MPHSA algorithm to get various outputs. And the number of iterations can also be extended until we get better solution to detect the target.

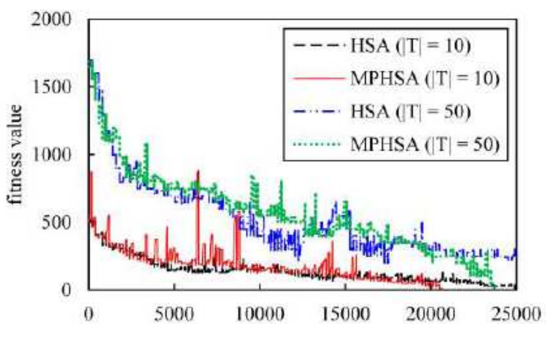

Fig: 6 Experimental comparisons when number of sensors |S| is 100 or 500.

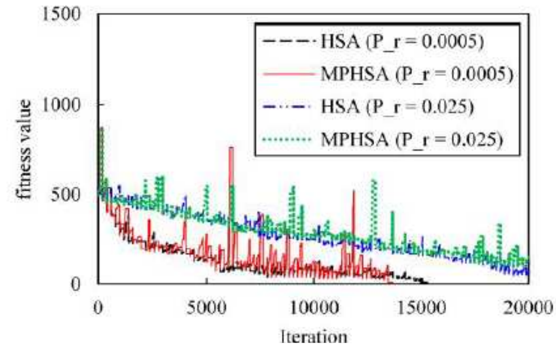

Fig: 7 Experimental comparison when *Pf* = 0.0005 or 0.025.

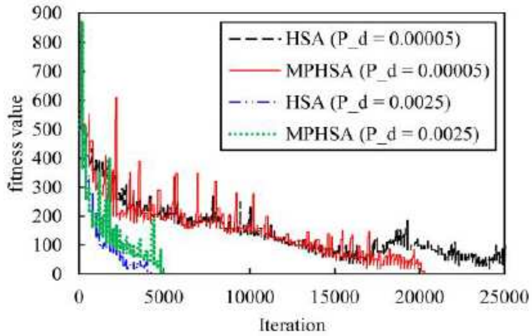

Fig: 8 Experimental comparison with *Pd* = 0.00005 or 0.0025.

IX. CONCLUSION

In this work we dynamically determined a sufficient number of active nodes in the UASN at different times to develop a sleep scheduling scheme. This work develops a MPHSA which yields better results than Genetic Algorithm. This works considers 3D Architecture of UASNs for more coverage area.

REFERENCES

[1] Chun-Cheng Lin, Member, IEEE, Der-Jiunn Deng, Member, IEEE, and Shang-Bin Wang "Extending the life time of Dynamic Underwater Acoustic Sensor Networks using Multi-population Harmony Search Algorithm" 10.1109/JSEN.2015.2440416, IEEE Sensors Journal

[2] P. Salvo Rossi, D. Ciuonzo, T. Ekman, and H. Dong, "Energy detection for MIMO decision fusion in underwater sensor networks," IEEE Sensors J., vol. 15, no. 3, pp. 1630-1640, 2015.

[3] M. Castelli, S. Silva, L. Manzoni, and L. Vanneschi, "Geometric selective harmony search," Inform. Sciences, vol. 279, pp. 468-482, 2014.

[4] S. Iyer and D. V. Rao, "Genetic algorithm based optimization technique for underwater sensor network positioning and deployment," in Proc. IEEE UT, 2015, pp. 1-6.

[5] W. Jiang, J. Wang, W. Wang, L.-L. Cao, and Q. Jin, "A parallel harmony search algorithm with dynamic harmony-memory size," in Proc. CCDC, IEEE Press, 2013, pp. 2342-2347.

[6] S. Ibrahim, J. Liu, M. Al-Bzoor, J.-H. Cui, and R. Ammar, "Towards efficient dynamic surface gateway deployment for underwater network," Ad Hoc Netw., vol. 11, pp. 2301-2312, 2013.

[7] G. Brataas, A. Lie, and T.A. Reinen, "Scalability analysis of underwater sensor networks," in Proc. MTS / IEEE. Conf. Oceans, 2013, pp. 1-9.