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# Cut Detection in Wireless Sensor Networks: A Survey

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**Abstract** - A wireless sensor network can get separated into multiple connected components due to the failure of some of its nodes, which is called a "cut." We propose a distributed algorithm to detect "CUT" in Wireless sensor networks, that mean the failure of any single node or set of node that separates the network in to two or more components. Algorithm is iterative and asynchronous i.e every node is communicate only those node that are in the rang. The convergence rate of the underlying iterative scheme is independent of the size and structure of the network. The algorithm consists of a simple iterative scheme in which every node updates a scalar state by communicating with its nearest neighbors. In the absence of cuts, the states converge to values that are equal to potentials in a fictitious electrical network.

## INTRODUCTION

Wireless Sensor Network (WSN) is made up of large number of sensor nodes and one sink node. Wireless sensor networks (WSNs) are a promising technology for monitoring large regions at high spatial and temporal resolution.

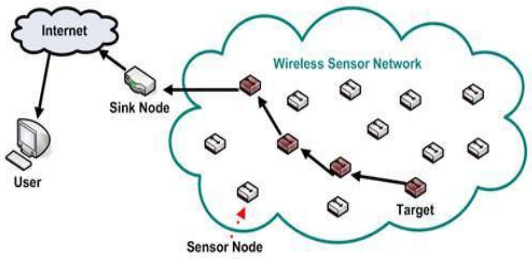


Fig : Wireless Sensor Network

Sensor node is small device made up of three basic units as sensor unit, processing unit and wireless communication (transceiver) unit equipped with limited power supply through batteries. Since the node has limited energy supply, these nodes are put in sleep mode to conserve energy which helps to prolong network life. Every node needs to communicate with only those nodes that are within its communication range. The convergence rate of the underlying iterative scheme is independent of the size and structure of the network. In the

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absence of cuts, the states converge to values that are equal to potentials in a fictitious electrical network. When a set of nodes gets separated from a special node, that is call a "source node", their states converge to 0 because "current is extracted" from the component but none is injected. These trends are used by every node to detect if a cut has occurred that has rendered it disconnected from the source. Although the algorithm is iterative and involves only local communication, its convergence rate is quite fast and is independent of the size of the network.

## DISTRIBUTED CUT DETECTION IN WSN

The algorithm propose here is distributed and asynchronous: it involves only local communication between neighboring nodes , and is robust to temporary communication failure between node pair. A key component of the DCD algorithm is a distributed iterative computational step through which the nodes compute their (fictitious) electrical potential. The convergence rate of the computation is independent of the size and structure of the network.

### Cut

A wireless sensor network can get separated in to multiple component due to failure of single sensor node or group of sensor node. This is called a CUT. In fact, node failure is expected to be quite common due to the typically limited energy budget of the nodes that are powered by small batteries. Failure of a set of nodes will reduce the number of multi-hop paths in the network. Such failures can cause a subset of nodes – that have not failed – to become disconnected from the rest, resulting in a "cut". Two nodes are said to be disconnected if there is no path between them.

### Source node

We assume that there is a specially designated node in the network, which we call the *source node*. The source node may be a base station that serves as an interface between the network and its users. Since a cut may or may not separate a node from the source node, we distinguish between two distinct outcomes of a cut for a particular node.

## DISTRIBUTED SOURCE SEPARATION DETECTION (DSSD) ALGORITHM

The state of a node converges to a positive value in the absence of a cut. If a node is rendered disconnected from the source as a result of a cut, its state converges to 0. By monitoring its state, therefore, a node can determine if it has been separated from the source node. In addition, the nodes that are still connected to the source are able to detect that, one, a cut has occurred somewhere in the network, and two, they are still connected to the source node. We call it the Distributed Source Separation Detection (DSSD) algorithm. We consider the problem of detecting cuts by the nodes of a wireless network. We assume that there is a specially designated node in the network, which we call the source node. The source node may be a base station that serves as an interface between the network and its users; the reason for this particular name is the electrical analogy introduced. Since a

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cut may or may not separate a node from the source node, we distinguish between two distinct outcomes of a cut for a particular node.

- DOS
- CCOS

## CCOS AND DOS

When a node u is disconnected from the source, we say that a DOS (Disconnected frOm Source) event has occurred for u. When a cut occurs in the network that does not separate a node u from the source node, we say that CCOS (Connected, but a Cut Occurred Somewhere) event has occurred for u. By cut detection we mean

(i) Detection by each node of a DOS event when it occurs, and

(ii) Detection of CCOS events by the nodes close to a cut, and the approximate location of the cut.

By "approximate location" of a cut we mean the location of one or more active nodes that lie at the boundary of the cut and that are connected to the source. Nodes that detect the occurrence and approximate locations of the cuts can then alert the source node or the base station.

## LITERATURE SURVEY

Nisheeth Shrivastava proposed a low overhead scheme for detecting a network partition or cut in a sensor network. They developed an algorithm for detecting ϱ linear cuts, which is a linear separation of on nodes from the base station. The reason for the restriction to linear cuts is that their algorithm relies critically on a certain duality between straight line segments and points in 2D, which also restricts the algorithm in to sensor networks deployed in the 2D plane. The algorithm developed in needs a few nodes called sentinels that communicate with a base station either directly or through multi-hop paths. The scheme for detecting cuts will choose a small subset of sensors, which act as sentinels. Each sentinel will communicate with the base station at a regular time interval. We assume that the base station is not attacked, and it always lies in the safe half plane $L+$. A communication failure from a sentinel is taken to mean that the sentinel has been cut off. Our problem now becomes: can one choose a small number of sensor nodes as sentinels so that every cut can be detected based solely on the live/dead status of sentinels, and the algorithm does not report false positives.

The base station detects ϱ-cuts by monitoring whether it can receive messages from the sentinels. In contrast to the algorithm in the DSSD algorithm proposed is not limited to ϱ-linear cuts; it can detect cuts that separate the network into multiple components of arbitrary shapes. Furthermore, the DSSD algorithm is not restricted to networks deployed in 2D, it does not require deploying sentinel nodes, and it allows every node to detect if a cut occurs.

The DSSD algorithm involves only nearest neighbor communication, which eliminates the need of routing messages to the source node. This feature makes the algorithm applicable to mobile nodes as well. Since the computation that a node has to carry out involves only averaging, it is

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particularly well suited to wireless sensor networks with nodes that have limited computational capability. Simulations are reported in that illustrate the capability of the algorithm to detect cuts in mobile networks, and also its ability to detect if a "reconnection" occurs after a cut. The DSSD algorithm has been demonstrated in an wireless testbed with MicaZ motes.

Kleinberg et al**.** Introduce the concept of ($\varepsilon$, $k$) - cut, which is defined as a network separation into two sets of nodes, namely $(1 - \varepsilon)n$ nodes and $\varepsilon n$ nodes ($n$ refers to the total number of nodes), caused by $k$ independently disabled edges. A set of *agents*, denoted by a set $D$, is strategically deployed in the network to detect the ($\varepsilon$, $k$)-cut. Each agent exchanges a control packet with other agents periodically. A cut is assumed to be present if the control message loss exceeds some threshold. Ritter et al. [4] proposed a cut detection algorithm where a sink node broadcasts an *a live message*. A cut is detected by *border* nodes, which are located on the border of network, if these nodes fail to receive the a live message more than a certain number of times.

Myounggyu Won proposes solutions for a more general cut detection problem – the *destination-based cut detection* problem. Unlike the traditional cut detection problem, Here an attempt to find a network cut between a sender and any node in a set of given destinations. Point-to-Point Cut Detection protocol (P2P-CD) is used. P2P-CD allows source node to identify a cut with respect to any destination node. In this protocol, the boundary of a cut is compactly represented as a set of linear segments. The compact representation of a cut allows the information on existing cuts to be efficiently distributed throughout the network with small overheads. A source node, using the distributed information, locally determines whether any potential destination is reachable.

Flooding based scheme**:** A flooding based scheme may also be used for detecting separations. Under node to- base flooding approach, every node periodically sends a time-stamped message to the base station. If the base station does not receive a new message from node i for a certain time interval, it can declare that i is disconnected from it. Base station floods the network with time-stamped beacon packets periodically. A node detects that it is disconnected from the base if the length of time during which it hasn't received a new packet from the base exceeds a threshold value.

Critical node detection A critical node is one whose removal renders the network disconnected.

## EXPERIMENTS

The communication in the wireless technology can be effectively over wireless channels with these three major domains

1. Wireless Transmission Channel
2. Routing Algorithm
3. Cut Detection

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**Route Discovery**

The selection of path for data transmission is done based on the availability of the nodes in the region using the ad-hoc on demand distance vector routing algorithm. By using the Ad hoc On demand Distance Vector (AODV) routing protocol, the routes are created on demand, i.e. only when a route is needed for which there is no "fresh" record in the routing table. In order to facilitate determination of the freshness of routing information, AODV maintains the time since when an entry has been last utilized. A routing table entry is "expired" after a certain predetermined threshold of time. Consider all the nodes to be in the position. Now the shortest path is to be determined by implementing the Ad hoc on Demand Distance Vector routing protocol in the wireless simulation environment for periodically sending the messages to the neighbors and the shortest path.

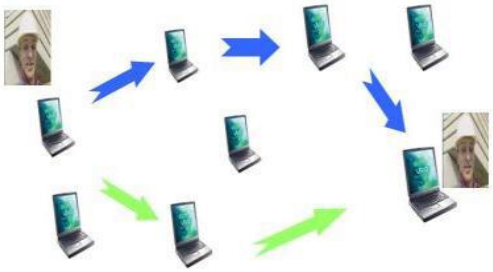

**Fig : Route Discovery**

**Route Maintenance**

The next step is the maintenance of these routes which is equally important. The source has to continuously monitor the position of the nodes to make sure the data is being carried through the path to the destination without loss. In any case, if the position of the nodes change and the source doesn't make a note of it then the packets will be lost and eventually have to be resent.

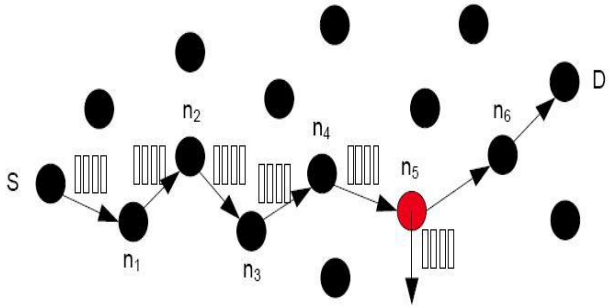


**Fig : Route Maintence**

**Data Transmission**

The path selection, maintenance and data transmission are consecutive process which happen in split seconds in realtime transmission. Hence the paths allocated priory is used for data transmission. The first path allocated previously is now used for data transmission. The data is transferred through the highlighted path. The second path selected is now used for data transmission. The data is transferred through the highlighted path. The third path selected is used for data transmission. The data is transferred through the highlighted path. When a node u is disconnected from the source, we say that a DOS (Disconnected from Source) event has occurred for u. When a cut occurs in the network that does not separate a node u from the source node, we say that CCOS (Connected, but a

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Cut Occurred Somewhere) event has occurred for u. By cut detection we mean 1) detection by each node of a DOS event when it occurs, and 2) detection of CCOS events by the nodes close to a cut, and the approximate location of the cut. In this article we propose a distributed algorithm to detect cuts, named the Distributed Cut Detection (DCD) algorithm. The algorithm allows each node to detect DOS events and a subset of nodes to detect CCOS events.

**Comparing the Algorithm**

**Algorithm : 1**

procedure DCD Consider S=Source node;
neighbors of node S are A,B.
ack=active;dack=inactive
if the node A is active i.e. ack state then
Wait for 500ms.
Send file to node A.
else if the node A is deactive nodefailed i.e. dack state
then
file sending to A failed.
if the node B is active i.e ack state then
Wait for 500ms.
Send file to node B.
else if the node B is deactive nodefailed i.e dack state then
file sending to B failed.

**Algorithm :2**

Threshold = 50%; success = 0; cutoff = 10%
A := S;
Repeat
If g(A) >= threshold then
B := A;
Let A be neighbor of B that minimizes
pc(B,A) = power-cost(B,A) + v(s)f'(A);
Send message to A;
success = 1;
Until A = D (* Destination reached *)
or if success <> 1 then
if threshold > cutoff then
threshold = threshold /2;
or A = B ( * Delivery failed *);

**DOS Detection**

As the name of algorithm says its Disconnected from source. To send packets we use Shortest path algorithm, it is based on energy that means at the time of sending packets from source sensors node to destination sensor node, due to throughput or any energy related issue packets are not reaching to destination. And that disturbance is from near to source sensor node. To resolve this problem we use the alternative shortest path. After repairing the cut, packets are transferred from earlier path. Diagram 1(a) shows cut occurred near to the source sensor node. Due to this it find some another alternative path to transferred a packets to destination sensor node. Diagram1(b) shows alternative shortest path.

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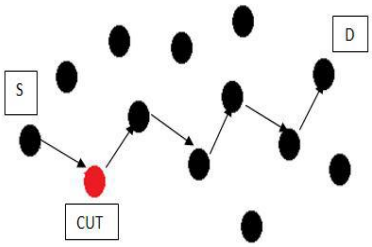


Fig : 1(a)

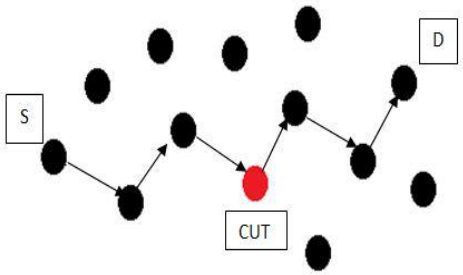


Fig:2(a)

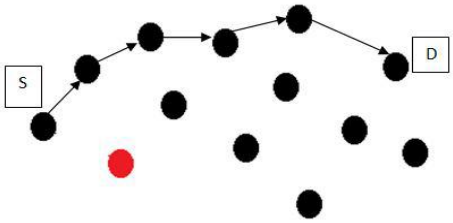


Fig :1(b)

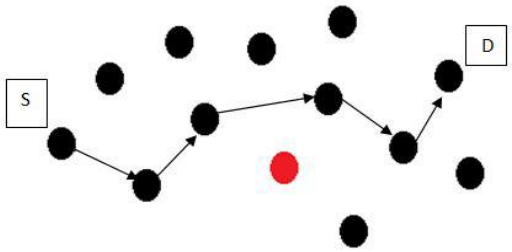


Fig : 2(b)

**CCOS Detection**

As the name of algorithm says its Connected but Cut Occurred From Source. At the time of sending packets cut is occurred somewhere middle in the path. To resolve this problem it uses alternative shortest path. Cut occurred in respective node, i.e node not having sufficient energy to pass the packets forward. Diagram 2(a) shows cut occurred in between the path. To resolve this, it does the same thing as done in DOS

**CONCLUSION**

A key component of the DCD algorithm is a distributed iterative computational step through which the nodes compute their electric potentials. The convergence rate of the computation is independent of the size and structure of the network. The DCD algorithm is used for every node of a wireless sensor network to detect Disconnected from Source events if they occur. Second, it is also used for a subset of nodes that experience CCOS events to detect them and estimate the approximate location of the cut in the form of a list of active nodes that lie at the

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boundary of the cut. The DOS and CCOS events are defined with respect to a specially designated source node. In this paper we made a comparative study on the cut detection algorithm. There are many issues in the DSSD algorithm but most of the algorithm deals only with the "cut" and "Detection".

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