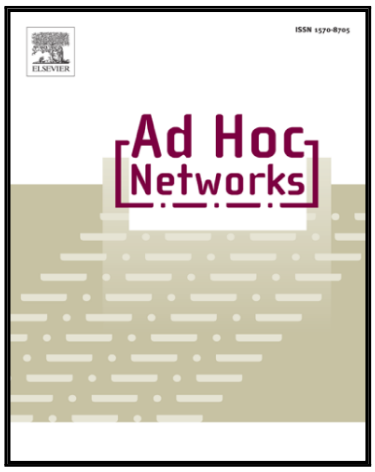

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D-LPCN: A Distributed Least Polar-angle Connected Node Algorithm for Finding the Boundary of a Wireless Sensor Network

Massinissa Saoudi[a,f,c], Ahcène Bounceur[a,f,*], Farid Lalem[a,f], Reinhardt Euler[a,f], M-Tahar Kechadi[c], Abdelkader Laouid[d], Madani Bezoui[b], Marc Sevaux[a,e]

[a] *Lab-STICC UMR CNRS 6285*
[b] *University of Boumerdes, Department of Mathematics, Boumerdes, Algeria*
[c] *Lab-CASL Laboratory,University College Dublin, Belfield, Dublin 4, Ireland*
[d] *LIMED Laboratory, University of Bejaia, 06000, Bejaia, Algeria*
[e] *Centre de Recherche, BP 92116, F-56321 Lorient, France*
[f] *Université de Bretagne Occidentale, 20 Avenue Victor Le Gorgeu, 29238 Brest, France*

Abstract

A boundary of wireless sensor networks (WSNs) can be used in many fields, for example, to monitor a frontier or a secure place of strategic sensitive sites like oil fields or frontiers of a country. This situation is modeled as the problem of finding a polygon hull in a connected Euclidean graph, which represents a minimal set of connected boundary nodes. In this paper we propose a new algorithm called D-LPCN (Distributed Least Polar-angle Connected Node) which represents the distributed version of the LPCN algorithm introduced in [1]. In each iteration, any boundary node chooses its nearest polar angle node among the neighbors of the node found in the previous iteration except the first node which has to be a boundary node. This node can be automatically determined using the Minimum Finding algorithm, which has two main advantages. The first one is that the algorithm works with any type of a connected network, given as planar or not. Furthermore, it takes into account any blocking situation and contains the necessary elements to avoid them. The second advantage is that the algorithm can determine all the boundaries of the different connected parts of the network. The proposed algorithm is validated using the CupCarbon, Tossim and Contiki simulators. It has also been implemented using real sensor nodes based on the TelosB and Arduino/XBee platforms. We have estimated the energy consumption of each node and we have found that the consumption of the network depends on the number of the boundary nodes and their neighbors. The simulation results show that the proposed algorithm is less energy consuming than the existing algorithms and its distributed version is less energy consuming than the centralized version.

Keywords: Distributed algorithms, Wireless Sensor Networks, Boundary detection, Energy consumption, Polygon hull.

*Corresponding author
Email addresses: Massinissa.Saoudi@univ-brest.fr (Massinissa Saoudi), Ahcene.Bounceur@univ-brest.fr (Ahcène Bounceur), Farid.Lalem@univ-brest.fr (Farid Lalem), Reinhardt.Euler@univ-brest.fr (Reinhardt Euler),