University Defence Research Centre (UDRC)
In Signal Processing

[O14] Distributed and Iterative Processing for Wireless Sensor Networks with Multiple Local Fusion Centres
Theme: Distributed Signal Processing

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Background

This work focuses on compressed sensing based distributed algorithm for status monitoring and surveillance with Wireless Sensor Networks (WSNs). Capitalizing on the spatial sparsity of events or signals, compressive data collection is enforced at fusion center (FC) only using a fraction of sensors, which increases the reliability of detection and conserves sensing energy and prolongs network lifetime.

• Existing approaches and shortcomings
    Little work has studied the WSN based on compressed sensing. In the existing distributed events detection methods, the instable topology of WSN may significantly affect the decision results. Existing distributed approaches (i) increase energy dissipation rates of sensor nodes, (ii) cause a lot of packet loss, which in turn diminish the network throughput and (iii) hinders fair event detections and reliable data transmissions.

• Anticipated benefits
    This work is to improve the detection reliability, the robustness of detection, decrease the communication burden, and extend the lifetime of WSNs. Each sensor monitors its local region only, collaborates with its neighboring sensors through low-power one-hop communication, and iteratively improves the local estimates until reaching the global optimum. More than 30% of communication load can be reduced in detection.

Technical Work

• Description of technical work.
    Each node monitors the local region rather than the entire large field. The fusion centers collected the readings from source nodes based on compressed sensing. Through collaboration with local fusion centers, the distributed consensus algorithm converges fast and the decision making is globally optimal. By doing this, the energy, communication and computation costs can be reduced.

• Current approach to solving issue/problem,
    Most current approaches focus on data transmission protocols, or congestion avoidance such as ESRT, CODA, which are trade-off between reliability and costs. Compressed sensing based approach makes it possible to increase detect accuracy but decrease costs.

• The novelty of the approach also needs to be highlighted
    The compressed sampling reduce the source of data without losing the detection accuracy, and the distributed consensus algorithm increases the reliability of decision making, which tolerance the failure of sensor nodes or links in WSN. The reduction of transmission and computation costs increases the lifetime of WSN.

Summary

This work aims at developing reliable distributed status monitoring and surveillance algorithm for WSNs, which tolerance the failure of nodes or links.

Exploitation & military relevance

This work can improve the reliability of distributed events detection, data collection, when some nodes or links failure in battle field. A number of applications in distributed wireless sensor networks (WSNs) can benefit from this solution.

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