An Efficient Geometric Inversion Based Approach to Hole Detection and Restoration in Wireless Sensor Networks

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Present hole-healing algorithms in wireless sensor networks often result in sub-optimal node placements or incur high computational overhead. In this paper, we develop the Geometric Inversion-Based Hole Restoration Algorithm (GIBHRA), a novel and efficient approach that formulates the hole healing task as the challenge of finding a maximally inscribed circle perfectly tangent to the three boundary nodes defining a coverage void. By applying geometric inversion, GIBHRA effectively calculates the mathematically optimal location for a new restorative node, thereby maximizing its potential coverage within the void. Simulation results demonstrate that GIBHRA is decisively superior to benchmark methods for coverage efficiency, node deployment, resource efficiency, and hole healing in areas with coverage holes.