Near-Field Sensing Range and Angle Using RSS-based Method

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RSS 기반 방법을 이용한 근거리장 거리 및 각도 센싱

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Abstract

Near-field integrated sensing and communication (ISAC) with extra-large arrays can enable high-resolution angle-range localization, but monostatic beam/focus scanning incurs high initial-access latency [1]. Exploiting projected-aperture non-uniform spherical-wave (PNUSW)-induced received signal strength (RSS) non-uniformity across the array [1], we estimate user range and bearing from per-element uplink RSS via maximum-likelihood (ML) fitting solved by particle swarm optimization (PSO) [2], avoiding exhaustive scanning and grid search.

Ⅰ. Introduction

In the electromagnetic near field, wave propagation is no longer well captured by a simple spherical-wave assumption, because each array element experiences different path lengths and projected apertures under the PNUSW [1]. As a result, the uniform linear array (ULA) observes a distinctive per-element received power pattern. We exploit this property to localize a newly arrived user equipment (UE) during initial access using only the UE transmit power and the RSS profile across the base-station (BS) array—without requiring symbol knowledge or phase synchronization.

Ⅱ. Method

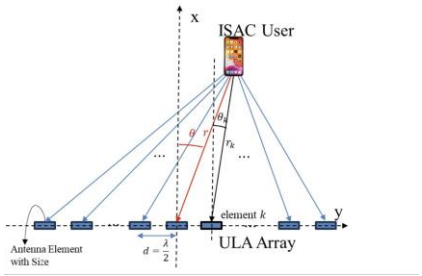

Figure System model.

In the near field, propagation follows the PNUSW model, so different antennas of a ULA receive different uplink power levels from the same user [1]. With a known channel model, the BS formulates a ML localization objective and uses PSO to search for the UE location without grid search.

Ⅲ. Conclusion

Overall, the proposed PNUSW-driven RSS profiling enables scan-free, grid-free near-field user localization during initial access with low complexity.

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