# Spatial Spectrum Hole Estimation via Signal Strength Measurement

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## Low Storage and Communication Overhead System to Find Spectrum Holes

**The Technology:**

The invention applies to frequency agile radios that can allow secondary users to share a fixed spectrum resource opportunistically with a set of primary nodes, which are licensed spectrum users. The technology is a distributed scheme in which frequency agile radios estimate the maximum power at which they can transmit without causing harmful interference to the primary users. The system relies on signal strength measurements, which are used to localize the primary transmitters and estimate their transmit powers. An approximation to the maximum interference-free transmit power (miftp) is derived using the Cramer-Rao lower bound on localization accuracy. ***Numerical studies have demonstrated the effectiveness of the invention under a variety of scenarios.***

Without using a grid scheme that requires considerable storage and communication overhead, the technology uses frequency agile radios to determine the position of and transmit power of a primary transmitter, resulting in an estimate of the primary transmitter's coverage area and thereby establishing the spectrum holes that are available for secondary user transmissions. The system then allows each frequency agile radio to measure the signal strength across channels in a range of "interest" and to determine the size of identified spectrum holes and their associated "miftp" values.

**Applications:**

- Military troop communications on foreign soil, using the foreign country's spectrum
- Augmented utilization for owners of licensed spectrum
- New wireless services that coexist in an existing primary wireless system
- Extended use of spectrum in rural areas
- Increased capacity for wireless cellular networks
- "Device to device" communication
- Effective in ad hoc networks (infrastructure-less networks) such as emergency communications, battlefield communications, and vehicular networks

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