



# Estimate Power Spectral Density (PSD) in a Network or Geographical Region (20110170, Dr. Georgios Giannakis)

**IP Status:** Issued US Patent; **Application #:** 13/899,374

## Channel gain (CG) mapping for wireless cognitive radio spectrum sensing

Channel gain (CG) mapping more precisely determines “white space” in the radio spectrum that can supply cognitive radio (CR) with the real-time information it needs to exploit its potential. CG maps cope with time-varying environments by capturing up-to-date channel gains from an arbitrary point in space. It can better estimate power usage at each frequency. This technology has a number of novel elements:

- gives more precise information about when channels become available for dynamic spectrum access,
- better predicts actual power densities from samples across the radio spectrum,
- promises to maximize how long a frequency can be “borrowed”,
- may provide information about the optimal power level that can be used at the frequency, and
- addresses fundamental situational awareness issues of any wireless system.

CG cartography bypasses the need for channel gain estimation using training (pilot) sequences that have access to both transmit and receive terminal. Channel gain estimation does not require access to receiver signals that other approaches rely on to estimate the sought link.

## Estimates power spectral density in given network/geographical region

New technologies addressing “spectrum scarcity” in wireless communications include cognitive radio (CR), a dynamic spectrum access (DSA) method communications devices use to find and use available signal capacity (white space) at frequencies licensed for use by other devices. In order for CR to efficiently provide solutions to data and video communications traffic congestion, it must determine in real time when a particular frequency is available for DSA. This new technology is a cooperative algorithm for estimating power spectral density (PSD) in a given network/geographical region. Cooperative sensing schemes can significantly improve performance relative to single cognitive radio sensing. This algorithm is the first approach capable of estimating channel gains of any potential link without explicit cooperation among devices.

## Phase of Development

- Concept. Algorithm developed. Simulations with real data.

## Benefits

- Supplies cognitive radio (CR) with real-time information
- Maximizes how long a frequency can be “borrowed”
- More precise information about channels available for dynamic spectrum access
- Better predicts actual power densities across radio spectrum

## Technology ID

20110170

## Category

Software & IT/Algorithms  
Software & IT/Communications &  
Networking

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## Features

- Channel gain (CG) mapping
- Determines “white space” in radio spectrum
- May provide information about optimal power levels that can be used at a given frequency
- Addresses fundamental situational awareness issues of any wireless system

## Applications

- Cognitive radio (CR)
- Wireless communications systems
- Mobile handsets, base stations and/or other network tools
- Network planning
- Spectrum sharing; spectrum sensing
- Monitoring and localization systems
- GPS-denied localization
- Possible applications in wireless telephony, Wi-Fi internet access, multimedia home networks, military communications, geo-location devices, smart grid, fleet management, alarm systems, remote monitoring including medical monitoring, smart modems

## Researchers

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## Publications

[Cooperative Spectrum Sensing for Cognitive Radios Using Krige Kalman Filtering](#)

*IEEE Journal of Selected Topics in Signal Processing*, Volume: 5 , Issue: 1 , Feb. 2011

[Channel Gain Map Tracking via Distributed Kriging](#)

*IEEE Transactions on Vehicular Technology*, Volume: 60 , Issue: 3 , March 2011

[Group sparse total least-squares for cognitive spectrum sensing](#)

*2011 IEEE 12th International Workshop on Signal Processing Advances in Wireless Communications*, 18 August 2011

[Spectrum sensing for cognitive radios using Krige Kalman filtering](#)

*2009 3rd IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP)*, 17 February 2010

[Sparsity-aware cooperative cognitive radio sensing using channel gain maps](#)

*2009 Conference Record of the Forty-Third Asilomar Conference on Signals, Systems and Computers*, 20 May 2010

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