
# An Improved Method for Analyzing Wireless Broadcasts

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WARF: P09135US

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**The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a more efficient method for recovering channel state information.**

## OVERVIEW

In wireless telecommunications, signals are transmitted and received over transmission channels within a limited range of frequencies, typically between 0.7 GHz to 6 GHz for domestic applications. Due to the limited amount of transmission space, it is increasingly important to perfect techniques that estimate channel state information (CSI) at the transmitter and/or receiver to maximize wireless performance over the multipath channels. In modern communication systems training-based channel learning techniques are commonly used to retrieve the CSI at the receiver, which can improve communication efficiency, particularly in terms of power and spectral efficiency.

Training-based methods probe the receiver channel with a multiplexed signal, consisting of known signal waveforms and information bearing signals, and process the corresponding channel output to learn the CSI. Multipath channels tend to exhibit an approximately sparse multipath structure at high signal space dimension (time-bandwidth-antenna product), where the CSI has significantly fewer dominant parameters. Due to the inherently low-dimensional nature of sparse multipath channels, conventional training-based methods are not appropriate since they are based on exhaustive probing coupled with a complex estimation approach comprising linear least squares or non-linear parametric estimators.

To accurately learn the channel response at the receiver and increase communication efficiency at high signal space dimensions, a new method is needed that will provide a fast response time, more efficient estimation strategies and training waveforms that are tailored for sparse multipath channel applications.

## THE INVENTION

UW-Madison researchers have developed a more efficient method for recovering CSI. This method uses a non-linear reconstruction algorithm that learns multipath channels in time, frequency and space. By tailoring training signals and estimation strategies to the

## THE WARF ADVANTAGE

Since its founding in 1925 as the patenting and licensing organization for the University of Wisconsin-Madison, WARF has been working with business and industry to transform university research into products that benefit society. WARF intellectual property managers and licensing staff members are leaders in the field of university-based technology transfer. They are familiar with the intricacies of patenting, have worked with researchers in relevant disciplines, understand industries and markets, and have negotiated innovative licensing strategies to meet the individual needs of business clients.

anticipated characteristics of the underlying channel, the researchers were able to yield better estimates than conventional procedures.

This approach improves the accuracy of learning the receiver channel response by focusing on two critical aspects of training-based channel learning methods, sensing and estimation. Sensing relates to the design and placement of training signals that are used to probe the channel. This method defines the most suitable transmitter training signals for exploiting multipath sparsity in angle, delay and/or Doppler. Estimation refers to the signal analysis process implemented at the receiver to recover the channel response. Researchers implemented non-linear reconstruction algorithms, based on convex/linear programming, that come within a logarithmic factor of the performance of an ideal channel estimator. This new approach clearly reveals how the relationship between the training signals and the accuracy of this algorithm efficiently estimates the CSI, resulting in faster channel responses at the receiver.

## BUSINESS OPPORTUNITY

- The market for the wireless communications industry continues to expand.
- In 1999 the industry posted revenues of $40 billion.
- The switch to digital television frees up bandwidth between about 50MHz and 700MHz, creating vast opportunities for new wireless applications.
- White space, an unused frequency, typically is found between used radio bands or channels to avoid interference, but this new method for recovering CSI may be utilized to efficiently transmit and receive signals over white space robustly enough to avoid destructive interference.
- By using radio frequencies fewer towers are needed to transmit signals, due to the inherent ability of shorter wavelengths to travel further distances without signal loss.

## APPLICATIONS

- Can be incorporated into wireless communication systems, including radar and underwater communication systems
- Analyzes “white space,” or unused radio frequencies, to provide improved signal transmission efficiency and bandwidth, while reducing destructive interference from adjacent signals

## KEY BENEFITS

- Improves accuracy and efficiency of wireless communication
- Reduces power/energy and bandwidth expenditure by more than 50 percent
- Provides lower latency in data transmission due to the higher fraction of bandwidth available for communication
- Provides improved robustness to noise and signal errors

## STAGE OF DEVELOPMENT

The development of this technology was supported by the WARF Accelerator Program. The Accelerator Program selects WARF’s most commercially promising technologies and provides expert assistance and funding to enable achievement of commercially significant milestones. WARF believes that these technologies are especially attractive opportunities for licensing.

## ADDITIONAL INFORMATION

**Related Technologies**

For more information about the inventor’s previous technologies for improving wireless communication technology, see WARF reference numbers:

P06176US

P06177US

**Tech Fields**

Information Technology - Telecommunications

## CONTACT INFORMATION

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846.