Interference Management for Concurrent Transmission in Downlink Wireless Communications

Tech ID: 33542 / UC Case 2010-050-0

BACKGROUND

It is well known that the communication capacity of wireless networks is limited by interference. Depending on the strength of the interference, there are three conventional approaches to this problem. If the interference is very strong, then the receiver can decode the interfering signal and subtract from the desired signal using successive interference cancelation. If the interference signal is very weak compared to the desired signal, it can be treated as noise. The third and most common possibility is when the interference is comparable with the desired signal. In this case the interference can be avoided by orthogonalizing it with the desired signal using techniques such as time division multiple access (TDMA) or frequency division multiple access (FDMA). In addition to interference, wireless networks also experience channel fading. Conventional approaches to wireless networking attempt to combat fading. Depending on the coherence time of the fading, various approaches have been used. For example, fast fading may be mitigated by the use of diversity techniques, interleaving, and error-correcting codes.

Certain diversity techniques, such as the use of multiple antennas, has been shown to help combat fading as well as increase multiplexing gain and system capacity. Multiuser diversity scheme is a technique to increase the capacity of wireless networks using multiple antennas at the base station. In this approach the base station selects a mobile device that has the best channel condition, maximizing the signal-to-noise ratio (SNR). According to some implementations of this approach, K random beams are constructed and information is transmitted to the users with the highest signal-to-noise plus interference ratio (SINR). Searching for the best SINR in the network, however, requires feedback from the mobile devices that scales linearly with the number of users. These implementations also use beamforming, which is complex to implement. In addition, the cooperation requirement is substantial.

TECHNOLOGY DESCRIPTION

To overcome these issues, researchers at UC Santa Cruz (UCSC) have developed new multiuser diversity technique for the downlink of wireless systems in which multiple mobile devices in a wireless system communicate with a base station at the same time and frequency. Unlike prior techniques that separately combat interference and channel fading, the present technique surprisingly uses channel fading to reduce the negative effects of interference. The result is very effective and achieves dirty paper coding (DPC) capacity asymptotically. Surprisingly, the technique does not require full channel state information (CSI) and only close to K integers related to CSI are fed back to the transmitter, where K is the number of antennas at the base station. Moreover, the encoding and decoding is significantly simpler than existing multiple-input, multiple-output (MIMO) schemes and is similar to point-to-point communications. Unlike prior approaches to multiuser diversity were based on searching for the best channels to use, UCSC researchers have discovered that searching simultaneously for the best and worse channels can lead to significant capacity gains. This discovered method can asymptotically achieve DPC capacity as the number of mobile devices in the network, M, increases.

APPLICATIONS

- wireless cellular networking

ADVANTAGES

- Through multiuser diversity a distributed MIMO system in the downlink of wireless networks is reduced to a group of parallel single-input single-output (SISO) systems.

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OTHER INFORMATION

KEYWORDS

networking, network protocols, networks, wireless networks, cellular, cellular networks, mobile networks, time division multiple access, frequency division multiple access, TDMA, FDMA, channel fading, single-input single-output, SISO, multiple-input multiple-output, MIMO

CATEGORIZED AS

- **Communications**
  - Internet
  - Networking
  - Wireless

RELATED CASES

2010-050-0

- Challenges and complexities related to space-time signal processing design in MIMO systems can be replaced by simple point-to-point communications.
- Achieves maximum capacity provided the number of mobile devices is adequate.
- Achieves the capacity of DPC (Costa) asymptotically.

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,191,093	11/17/2015	2010-050

RELATED MATERIALS

- Garcia-Luna-Aceves, J. J. "Adaptive Diversity Based Spectrum Allocation in Single-Radio Wireless Ad Hoc Networks." (2010). - 11/08/2010

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Differentiating Congestion Vs. Random Loss: A Method For Improving TCP Performance Over Wireless Links
- Compact Key with Reusable Common Key for Encryption
- Scalable Integrated Services Architecture for Computer Networks
- Carrier Sense Multiple Access With Collision Avoidance And Pilots (CSMA/CAP)
- Extra-Compact Key with Reusable Common Key for Encryption
- Compact Key Encoding of Data for Public Exposure Such As Cloud Storage
- Tree-Based Ordered Multicasting in Computer Networks

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