Interleaved Training And Limited Feedback For Multiple-Antenna Systems

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BRIEF DESCRIPTION

Multi-antenna communication schemes provide greater link quality and reliability than single antenna systems, but also require coordination between the antennas for maximum effect. The traditional method of training (aligning) the antennas before data transmission becomes infeasible for arrays with many transmitters. The inventors at UCI have made many antennas accessible by interleaving the training and feedback stages.

FULL DESCRIPTION

The performance of a wireless communication system can be greatly improved by making the channel state information (CSI) available at the transmitter and the receiver. This information describes how a signal propagates from the transmitter to the receiver and represents the combined effect of, for example, scattering, fading, and power decay with distance. The CSI makes it possible to adapt transmissions to current channel conditions, which is crucial for achieving reliable communication with high data rates in multi-antenna systems. In a massive multiple-input single-output (MISO) system, having CSI at the transmitter (CSIT) is especially desirable as one can then fully exploit the performance gains promised by the large number of transmitter antennas via CSI-adaptive transmission strategies such as beamforming. A typical way to acquire CSIT is channel training followed by (digital) feedback.

Training and feedback are traditionally viewed as two non-interleaving processes. According to this traditional viewpoint, for each channel state, the transmitter first trains all of its antennas at once, so that the receiver acquires the entire CSI. The conventional scheme appears to be infeasible in the case of a massive MISO system. Even the training phase, by itself, would be very challenging to realize due to the large number of transmitter antennas that need to be trained. Conventional limited feedback schemes do not provide much hope in this context. The feedback rates required for even the simplest of the limited feedback schemes such as antenna selection grow without bound as the number of transmitter antennas grow to infinity.

The inventors at UCI have developed a method to interleave the training and feedback stages in a multiple-antenna communication system. The transmitter trains its antennas one by one and receives feedback information immediately after training each one of its antennas. The feedback message may ask the transmitter to train another antenna; or, it may terminate the feedback/training phase and provide the quantized codeword (e.g., a beamforming vector) to be utilized for data transmission. If the already-trained antennas provide sufficiently favorable conditions for data transmission, one can then terminate the training phase and thus avoid wasting more resources on training the rest of the antennas. The method makes possible the design of multi-antenna communication systems, whose feedback and training overheads remain completely independent of the number of transmitter antennas, and which, at the same time, can achieve the same performance as a system with perfect transmitter and receiver CSI.

ADVANTAGES

§ Antenna training and feedback overheads remain completely independent of the number of transmitter antennas

§ Achieves the same performance as a system, with perfect transmitter and receiver CSI

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OTHER INFORMATION

CATEGORIZED AS

» **Communications**
» Other
» Wireless

RELATED CASES

2015-931-0

§ Method can be extended to multiple-input multiple-output (MIMO) systems or to multiuser scenarios with different performance measures

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,116,372	10/30/2018	2015-931

STATE OF DEVELOPMENT

The invention has been practiced in a multi-antenna communication system which comprises a single-user point-to-point MISO system and Multiple-Input Multiple-Output (MIMO) system

RELATED MATERIALS

» Erdem Koyuncu, Hamid Jafarkhani, "Interleaving training and limited feedback for point-to-point massive multiple-antenna systems", Information Theory (ISIT) 2015 IEEE International Symposium on, pp. 1242-1246, 2015, ISSN 2157-8117. - 06/14/2015

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