METHOD OF PRECODER INFORMATION FEEDBACK IN MULTI-ANTENNA WIRELESS COMMUNICATION SYSTEMS

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates generally to wireless communications and, more particularly, to a feedback framework in wireless communication systems.

BACKGROUND

[0002] In wireless communication systems, channel state information at a transmitter, for example, at a base station, is important for beam-forming transmissions (also referred to as precoding) that deliver more power to a targeted user while minimizing interference on other users. Precoding operations can be in the context of single-user multiple input multiple output (SU-MIMO) or multi-user MIMO (MU-MIMO), where two or more users are served by a single base station. An eNB needs accurate spatial channel information in order to perform a high rank transmission to a single UE or to perform precoding to two or more UEs simultaneously so that the mutual interference among multiple transmissions can be minimized at each UE.

[0003] Precoding operations may also be in the context of SU/MU-MIMO users served by coordinated multi-point (CoMP) transmissions where antennas belonging to different eNBs, rather than to the same eNB, can coordinate their precoding to serve multiple users simultaneously. Further support for up to eight transmit antennas is enabled in the next generation cellular standards like 3GPP LTE Release-10. Due to such a relatively large number of antennas (4-Tx or 8-Tx) involved in such transmissions, it is desirable that the UE feedback be designed efficiently with good performance overhead trade-off, so that feedback does not scale linearly with the increasing number of antennas.

[0004] The antenna configurations which support a large number of antennas in practice must allow large beamforming gains and also larger spatial multiplexing gains achieved from higher rank transmission. Beamforming allows efficient support for low geometry users and also for multi-user transmission thereby improving cell-edge and cell-average throughput with larger number of users in the system, while spatial multiplexing allows higher peak spectral efficiency. A typical antenna configuration to achieve this would be to have groups of antennas where each group is a set of correlated antennas and each group is uncorrelated with the other groups. A cross-polarized antenna configuration is one such setup. The correlated antenna elements provide the required beamforming gains and the uncorrelated antenna elements enable high rank transmissions.

[0005] The above structure in the antennas has some unique spatial characteristics that can be exploited. For example, the correlation among correlated antennas changes slowly and is confined to a smaller vector space on an average. This can be used to feedback the correlated and uncorrelated channel characteristics, i.e., two components, at different rates and/or with different levels of quantization/overhead in time and frequency to reduce feedback overhead. One of the components representing the correlated channel characteristics can be fed back on a wideband basis and/or slowly in time, while the other component is fed back on a subband basis and/or more frequently in time.

[0006] However, one of the key challenges in designing such a two component feedback system is identifying the parameters used in the two components and the construction of the final precoder matrix as a function of the two components.

[0007] The various aspects, features and advantages of the invention will become more fully apparent to those having ordinary skill in the art upon a careful consideration of the following Detailed Description thereof with the accompanying drawings described below. The drawings may have been simplified for clarity and are not necessarily drawn to scale.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 illustrates a wireless communication system.

[0009] FIG.2 illustrates an embodiment with a base station transmitting to a device.

[00010] FIG.3 illustrates an example of a frame structure used in the 3GPP LTE Release-8 (Rel-8) specification and different reference symbols.

[00011] FIG. 4 illustrates exemplary antenna configurations at a base unit.

[00012] FIG. 5 illustrates a first subset of antennas and a second subset of antennas transmitting two spatial layers to a device.

[00013] FIG. 6 illustrates a wideband and subbands, each of which is further composed of contiguous subcarriers.

DETAILED DESCRIPTION

[00014] In FIG. 1, a wireless communication system 100 comprises one or more fixed base infrastructure units 110 and120 forming a network distributed over a geographical region for serving remote units in the time and/or frequency domain. The base infrastructure unit may also be referred to as the transmitter, access point (AP), access terminal (AT), base, base station (BS), base unit (BU), Node-B (NB), enhanced Node-B (eNB), Home Node-B (HNB), Home eNB (HeNB) or by other terminology used in the art. The base units are generally part of a radio access network that includes one or more controllers communicably coupled to one or more corresponding base units. The access network is generally communicably coupled to one or more core networks, which may be coupled to other packet or data networks, like the Internet, and to public switched telephone networks (PSTN), among other networks. These and other elements of access and core networks are not illustrated but they are well known generally by those having ordinary skill in the art.

[00015] The one or more base units each comprise one or more transmitters for downlink transmissions and one or more receivers for receiving uplink transmissions from the remote units as described further below. The one or more base units serve a number of remote units, for example, remote unit 102 and 104 in FIG. 1, within a corresponding serving area, for example, a cell or a cell sector of the base unit, via a wireless communication link. The remote units may be fixed units or wireless communication devices. The remote unit may also be referred to as a receiver, subscriber station (SS), mobile, mobile station (MS), mobile terminal, user, terminals, user equipment (UE), user terminal (UT) or by other terminology used in the art. The remote units also comprise one or more transmitters and one or more receivers. In FIG. 1, the base unit 110 transmits downlink communication signals to serve remote unit 102 in the time and/or frequency domain. The remote unit 102 communicates directly with base unit 110 via uplink communication signals.

[00016] The term "transmitter" is used herein to refer to a source of a transmission intended for receipt by a user or receiver. A transmitter may have multiple co-located antennas each of which emits, possibly different, waveforms based on the same information source. In FIG. 1, for example, antennas 112 and 114 are co-located. A transmitter is typically associated with a cell or a cell sector in the case of a base unit having or serving multiple sectors. Also, if a base unit has geographically separated antennas (i.e., distributed antennas with remote radio heads), the scenario is also referred to as "a transmitter". Thus generally one or more base units transmit information from multiple antennas for reception by a remote unit.

[00017] In the diagram 200 of FIG. 2, at 210, a base unit transmits from a plurality of antennas. Also in FIG.2, a remote unit receives transmissions from a plurality of antennas, which may or may not be co-located. In a typical embodiment, a base unit may be associated with a cell-ID, by which it identifies itself to a remote unit. As a conventional mode of operation, also sometimes referred to as a single-point transmission scheme, a remote unit 240 receives transmissions from a plurality of antennas of a single base unit 210. Such a base unit is also referred to as a serving cell (or serving base unit) to the user device/remote unit.

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