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(54) Title: METHOD FOR CONTROLLING THE WEIGHTING OF A DATA SIGNAL IN THE AT LEAST TWO ANTENNA ELEMENTS OF A RADIO CONNECTION UNIT, RADIO CONNECTION UNIT, MODULE AND COMMUNICATIONS SYSTEM

(57) Abstract: The invention relates to a method for controlling the weighting of a data signal in the at least two antenna elements of a first radio connection unit of a radio communications system, which data signal is to be distributed for parallel transmission to a second radio connection unit to at least two beams. In order to improve such a method, it comprises: determining in the second radio connection unit a weight information enabling the first radio connection unit to determine the sets of weights for suitable beams for transmission and transmitting it to the first radio connection unit; and distributing the data signal in the first radio connection unit to those sets of weights and transmitting the data signals simultaneously via the formed beams. Alternatively or additionally, the second unit determines the number of beams to be used and informs the first unit about it. The invention equally relates to corresponding radio connection units, radio connection unit modules and radio communications systems.

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Method for controlling the weighting of a data signal in the at least two antenna elements of a radio connection unit, radio connection unit, module and communications system

FIELD OF THE INVENTION

The invention relates to a method for controlling the weighting of a data signal in the at least two antenna elements of a first radio connection unit of a radio communications system, which data signal is to be distributed to at least two beams for parallel transmission of the data signal in at least two at least partly different streams to a second radio connection unit with at least one antenna element, the beams being formed by weighting the data signal in the antenna elements with a set of weights for each beam. The invention equally relates to a radio connection unit, a radio connection unit module and a radio communications system to be employed for such a method.

BACKGROUND OF THE INVENTION

It is known from wireless communications systems of the state of the art to transmit data signals between two radio connection units, in particular from a base station to a terminal, in parallel via several transmit antenna elements. When using multiple antennas with adapted transmission and detection techniques, the spatial dimension can be exploited

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at the terminal and the spectral efficiency of fading wireless channels can be increased significantly compared to conventional single antenna links. A terminal receiving signals from such a transceiver can be designed to distinguish several channels, if they are sufficiently uncorrelated.

The document "Link-Optimal BLAST Processing With Multiple-Access Interference" by F.R. Farrokhi, G.J. Foschini, A. Lozano, R.A. Valenzuela, Bell Laboratories (Lucent Technologies) in IEEE Vehicular Technology Conference, Boston, Massachussets, USA, Sept. 24-28, 2000, proceeds from a wireless communications system with antenna arrays at both, transmitter and receiver. The system transmits parallel data streams simultaneously and in the same frequency band, using the multiple antennas. With rich propagation, the different streams can be separated at the receiver because of their distinct spatial signatures. It is proposed to make the channel and the interference covariance available to the transmitter. The transmitter finds the channel eigenmodes in the presence of the interference and sends multiple independent data streams through those eigenmodes. The total transmitted power is distributed among the eigenmodes according to an optimal water-fill process. Thereby, the maximised capacity is supposed to be achieved. The method, as described above, always assumes that the receiver has at least two antenna elements. Preferably, in the aforementioned concept, the number of transmit and receive elements is the same.

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The parallel transmission via a plurality of antenna elements in transceiver and terminal enables a reduction of Eb/No (Eb = energy per bit; No = noise power density per Hz) requirements for achieving data rates associated with higher order constellations like 8PSK, 16QAM, or 64QAM. Moreover, it enables the expansion of the number of rate options for adaptive modulation and coding (AMC) and an increase of the maximum rate.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a further improved method for controlling the weighting of a data signal in the at least two antenna elements of a transceiver of a wireless communications system which allows for high data rates in the downlink matched to channel conditions.

This object is reached on the one hand by a first method for controlling the weighting of a data signal in the at least two antenna elements of a first radio connection unit of a radio communications system, which data signal is to be distributed to at least two beams for parallel transmission of the data signal in at least two at least partly different streams to a second radio connection unit with at least one antenna element, the beams being formed by weighting the data signal in the antenna elements with a set of weights for each beam, the method comprising:

- determining in the second radio connection unit a weight information enabling the first radio connection unit to

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determine the sets of weights for at least two suitable beams for transmission of a data signal from the first radio connection unit to the second radio connection unit;

- transmitting the determined weight information to the first radio connection unit; and
- distributing the data signal in the first radio connection unit to at least two sets of weights determined from the received weight information and transmitting the data signals simultaneously via the at least two formed beams.

With regard to this first method, the invention proceeds from the idea that the second radio connection unit is in possession of the most comprehensive information relevant for selecting suitable beams for transmission of the data signal and for determining sets of weights for the selected beams. It is therefore proposed to calculate all relevant information needed for the weighting of the data signals in the antenna elements of the first radio connection unit already at the second radio connection unit. The feedback information includes a weight information from which the first radio connection unit can determine the set of weights for each beam that is to be used for transmission of the data signals from the first radio connection unit to the second radio connection unit. Each feedback information indicates the weighting of the data signal for each of the different antenna elements of the first radio connection unit. This way, the information needed for obtaining the weight sets can be determined with the full information

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