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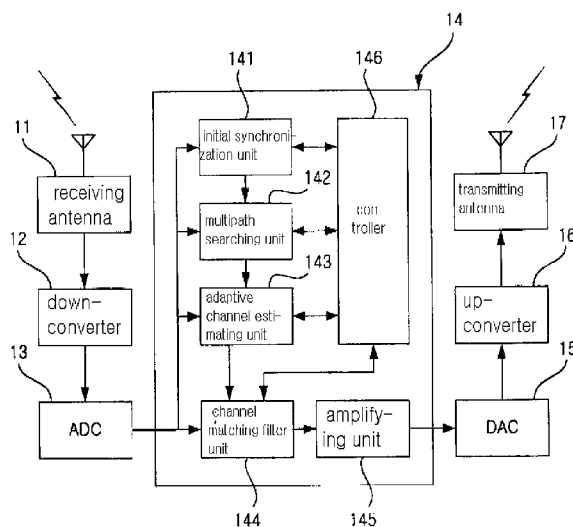
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(54) Title: APPARATUS AND METHOD FOR CANCELLATING INTERFERENCE SIGNAL OF MOBILE COMMUNICATION REPEATER



(57) Abstract: An apparatus and method for canceling an interference signal of a mobile communication repeater are provided. In a mobile communication system employing a wideband CDMA scheme, when a downlink received signal transmitted from a base station is input to a receiving antenna of a repeater as several multipath fading signals and a transmitted signal transmitted to a transmitting antenna of the repeater is also input to the receiving antenna of the repeater again, an apparatus for canceling the interference signal composed of an initial synchronization unit, a multipath searching unit, an adaptive channel estimating unit, a channel matching filter unit and a control unit is used to cancel both the multipath interference signal and the reverse signal through multipath selection and channel estimation using pilot signal searching, thereby providing a terminal within a service area of the repeater with a downlink signal of high quality.

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Description

APPARATUS AND METHOD FOR CANCELLATING INTERFERENCE SIGNAL OF MOBILE COMMUNICATION REPEATER

Technical Field

- [1] The present invention relates to an apparatus and method for canceling an interference signal of a mobile communication repeater, and more particularly, to an apparatus and method for canceling a multipath fading signal input to a receiving antenna of a repeater and an interference signal due to a reverse signal through multipath selection and channel estimation using pilot signal searching.

Background Art

- [2] In general, a repeater used in a cellular mobile communication system is installed within a transmission interval for serving a terminal in a shadow zone with a signal of high quality.
- [3] FIG. 1 is a conceptual diagram illustrating an operating environment of a repeater.
- [4] Referring to FIG. 1, a repeater 1 which has received a weak signal as a base station signal amplifies the base station signal to transmit it to a service area within a shadow zone, and amplifies a received terminal station signal within the service area to transmit it to the base station.
- [5] Also, various signal components are input to a receiving antenna 2 of the repeater 1. Examples of signals input to the receiving antenna 2 of the repeater 1 include, as shown in FIG. 1, a signal S1 incoming directly from a target base station 4, a multipath signal MPS1 thereof, a signal S2 incoming from a neighboring base station 5, a multipath signal MPS2 thereof, a reverse signal RS which is transmitted from a transmitting antenna 3 of the repeater 1 and then comes back to the receiving antenna 2 of the repeater 1 because the transmitted signal TS and the received signal of the repeater 1 use the same frequency band, and so forth.

Disclosure of Invention

Technical Problem

- [6] Various methods are used for canceling an interference signal in the repeater 1 where the transmitted and received signals co-exist. One representative method is provided with a function for canceling oscillation due to the reverse signal RS or reducing interference due to the reverse signal RS by reducing the power of a re-transmitted signal. Another typical method is to ensure spacing between transmitting and receiving antennas 3 and 2, or install the antennas with a specific structure

disposed therebetween, etc. Also, the mobile communication repeater 1 is provided with a function for canceling an interference signal incoming from a neighboring base station 5.

[7] In particular, in order to cancel oscillation due to the reverse signal, some conventional repeaters emit test signals from transmitting antennas to measure components of the signals input to respective receiving antennas. This test signal is emitted in a frequency band used in a mobile communication system, and thus acts as an interference signal in the existing system and should be frequently transmitted in order to make its transmission rate and an update frequency of channel estimation high enough to adapt to channel changes.

[8] Also, the repeater generally uses a directional antenna toward a target base station. This reduces a component of a signal incoming from a neighboring base station, however an interference signal due to a multipath signal received from the target base station along with a reverse signal between repeater antennas significantly affects a quality of a base station downlink signal. Also, a repeater having a function for canceling reverse interference by transmitting a test signal can only estimate a channel between repeater antennas and thus cannot cancel a signal received from a base station when the received signal is of a multipath fading type.

[9]

Technical Solution

[10] In order to solve the foregoing and/or other problems, it is an objective of the present invention to provide an apparatus and method for canceling an interference signal of a mobile communication repeater, which adaptively operates in a radio environment, by removing a multipath interference signal of a target base station input from a receiving antenna of the mobile communication repeater and a reverse signal between the repeater antennas through searching for a common pilot signal and channel estimation.

[11] In one aspect, the invention is directed to an apparatus for canceling an interference signal of a mobile communication repeater, the apparatus including: a receiving antenna; a down-converter for down-converting the received signal through the receiving antenna into a baseband or intermediate frequency band signal; an analog/digital converter for converting the baseband or intermediate frequency band signal into a digital signal; an interference canceling unit for canceling the interference signal through multipath selection and channel estimation using pilot signal searching with respect to the multipath signal input from a base station and a reverse signal coming back to the receiving antenna after being transmitted to a transmitting antenna to be described below; a digital/analog converter for converting the signal output from the

interference canceling unit into an analog signal; an up-converter for up-converting the analog signal into a Radio Frequency (RF) signal; and the transmitting antenna for transmitting the RF signal output from the up-converter. Here, the interference canceling unit includes: an initial synchronization unit for performing slot synchronization, frame synchronization, code group synchronization and scrambling code search on a wideband Code Division Multiple Access (CDMA) system; a multipath searching unit for searching for a multipath signal component input within an interval determined based on optimal symbol timing information and the scrambling code obtained by the initial synchronization unit; an adaptive channel estimating unit for estimating a received power and a phase for a multipath component that exceeds a threshold obtained by the multipath searching unit to measure an impulse response of a channel; a channel matching filter unit for deriving a reverse channel function based on the channel information obtained by the adaptive channel estimating unit and canceling the interference signal through filtering; and a controller connected to and controlling overall operation of the initial synchronization unit, the multipath searching unit, the adaptive channel estimating unit, and the channel matching filter unit.

- [12] In another aspect, the invention is directed to a method of canceling an interference signal of a mobile communication repeater including the steps of: performing, at an initial synchronization unit, slot synchronization and frame synchronization, code group synchronization, and scrambling code synchronization on a signal received through a receiving antenna; after completion of synchronization, setting, at a multipath searching unit, a search window determined by the number of tabs of the channel matching filter unit from starting positions of initial slot synchronization and frame synchronization for acquiring the initial synchronization of a wideband CDMA base station to search for power of a multipath signal; estimating, at an adaptive channel estimating unit, powers and phases of a reverse channel of the repeater and a multipath channel of the base station; calculating, at a channel matching filter unit, a reverse channel response for the channel obtained through the multipath channel searching to filter the received signal; and amplifying the filtered signal.

[13]

Advantageous Effects

- [14] As described above, some conventional repeaters provide a simple function for canceling an interference signal in order to prevent oscillation due to a reverse signal. However, an apparatus and method for canceling an interference signal of a mobile communication repeater according to the present invention can effectively cancel a multipath signal received from a base station as well as a reverse signal of the repeater, so that a terminal within a service area can be provided with a signal of high quality.

Brief Description of the Drawings

- [15] The foregoing and other objects, features and advantages of the invention will become more apparent from the following detailed description of exemplary embodiments of the invention, as illustrated in the accompanying drawings. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.
- [16] FIG. 1 is a conceptual diagram illustrating an operating environment of a repeater.
- [17] FIG. 2 is a block diagram illustrating a control circuit of an apparatus for canceling a multipath signal of a wideband CDMA system in accordance with an exemplary embodiment of the present invention.
- [18] FIG. 3 is a block diagram illustrating control circuits of a multipath searching unit and an adaptive channel estimating unit in accordance with an exemplary embodiment of the present invention.
- [19] FIG. 4 is a block diagram illustrating a control circuit of a channel matching filter unit in accordance with an exemplary embodiment of the present invention.
- [20] FIG. 5 is a flowchart illustrating a method of canceling a multipath signal in accordance with an exemplary embodiment of the present invention.

[21]

Mode for the Invention

- [22] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.
- [23] FIG. 2 is a block diagram illustrating a control circuit of an apparatus for canceling a multipath signal of a wideband CDMA system in accordance with an exemplary embodiment of the present invention.
- [24] As shown in FIG. 2, a repeater having an apparatus for canceling a multipath signal according to the present invention includes a receiving antenna 11, a down-converter 12 for down-converting a received signal into a base band or intermediate frequency signal, an analog/digital converter (ADC) 13 connected to an output end of the down-converter 12 and converting the down-converted base band or intermediate frequency signal into a digital signal, an interference canceling unit 14 for canceling interference due to a reverse signal and a multipath interference signal of a base station, a digital/analog converter (DAC) 15 connected to an output end of the interference canceling unit 14 and converting a digital signal into an analog signal, an up-converter 16 connected to an output end of the DAC 15 and up-converting an output signal of the DAC into a RF frequency band signal, and a transmitting antenna 17 connected to an output end of the up-converter 16 and transmitting a signal to a terminal station within a service area.

- [25] Here, the interference canceling unit 14 is composed of an initial synchronization unit 141 for performing slot synchronization, frame synchronization, code group synchronization, and scrambling code searching on a wideband CDMA system, a multipath searching unit 142 for searching for components of multipath signals input to an interval determined based on scrambling code and optimal symbol timing information obtained by the initial synchronization unit 141, an adaptive channel estimating unit 143 for performing a channel estimating function by estimating a phase and a received power of a multipath component that exceeds a threshold obtained by the multipath searching unit 142, a channel matching filter unit 144 for canceling an interference signal by performing a reverse channel function from channel information obtained by the adaptive channel estimating unit 143, an amplifying unit 145 for amplifying a signal for transmitting data of higher quality to a terminal station within a service area, and a controller 146 for controlling overall functioning for canceling interference.
- [26] The initial synchronization unit 141 of the mobile communication system using the wideband CDMA scheme performs synchronization through a three-step cell searching procedure.
- [27] That is, in the first step of cell searching, a primary synchronization channel is used to rapidly find a slot starting point. The primary synchronization channel is composed of Generalized Hierarchical Golay (GHG) codes having an unmodulated 256-chip length, and the same codes are transmitted per each slot so that a matching filter is used for a primary synchronization code to find the slot starting point.
- [28] In the second step of cell searching, a secondary synchronization channel is used to find a frame starting point and a scrambling code group. While the secondary synchronization channel use codes having the same 256-chip length as the primary synchronization channel, a different code is transmitted per each slot. The secondary synchronization channel uses hopping sequences and corresponds to a code group where a scrambling code used by the present base station belongs. The number of scrambling codes used in a wideband CDMA system is 8192 in total, which is divided into 64 code groups, 8 scrambling code sets are present per each code group, and each of the scrambling code sets is composed of one primary scrambling code and 15 secondary scrambling codes. There are 64 different secondary synchronization channel code sequences in the whole system, and the frame starting position and the scrambling code group are determined through these hopping sequences.
- [29] In the third step of cell searching, a correlation is calculated for finding one primary scrambling code transmitted through a common pilot channel among 8 primary scrambling codes from the code group obtained by the second step of cell searching, and the primary scrambling code having the highest correlation is found.

- [30] FIG. 3 is a block diagram illustrating control circuits of a multipath searching unit and an adaptive channel estimating unit in accordance with an exemplary embodiment of the present invention.
- [31] First, the multipath searching unit 142 searches for a component of a multipath signal input to a search window determined based on optimal symbol timing information and the primary scrambling code obtained by the initial synchronization unit.
- [32] The search window is equal to the number of taps of a channel matching filter.
- [33] The multipath searching is determined through a correlation with the primary scrambling code transmitted through the common pilot channel. The multipath components within the search window are determined through the correlation between a received signal and a primary scrambling code shifted at an interval of $1/N$ chip. Here, N denotes the number of samples per chip.
- [34] A common pilot channel of a base station spreads $1+j$ data to a primary scrambling code on a 256-chip basis and then transmits the data, and the multipath searching unit accumulates energy resulting from coherent accumulation of the correlations obtained by complex de-spreading on a 256-chip basis to calculate energy of the multipath components.
- [35] Referring to FIG. 3, a code phase control unit 1422 controls the code to be shifted at an interval of $1/N$ within the search window, and a code generator 1423 generates a scrambling code obtained by the initial synchronization unit 141 under the control of code phase control unit 1422. A correlator 1421 calculates a complex correlation between a received signal and a scrambling code generated by the code generator 1423, and a coherent accumulator 1424 accumulates the correlation obtained by the correlator 1421 on a 256-chip basis. An incoherent energy accumulator 1425 incoherently accumulates the energy of the correlation obtained by the coherent accumulator 1424 on a 256-chip basis by a determined number. A multipath signal discriminating unit 1426 receives signal energy per each path phase from the incoherent energy accumulator 1425, identifies a path whose signal energy exceeds a threshold, and transmits it to the controller 146.
- [36] The adaptive channel estimating unit 143 then estimates phases and signal powers of multipath components delivered from the multipath searching unit 142, and performs a procedure of coherently obtaining a correlation in order to obtain the phase and the signal power of each multipath component. Meanwhile, the multipath searching unit incoherently accumulates the correlation obtained on a 256-chip basis to obtain the energy of the multipath.
- [37] Referring to FIG. 3, a code phase control unit 1432 controls the code to be generated in the multipath position obtained by the multipath searching unit 142, and a

code generator 1433 generates a scrambling code obtained by the initial synchronization unit 141 under the control of code phase control unit. A correlator 1431 calculates a complex correlation between a received signal and a scrambling code generated by the code generator 1433, and a coherent accumulator 1434 accumulates the correlation obtained by the correlator 1431 on a 256-chip basis to obtain a power and a phase of each path. Repeating an operation of the coherent accumulator 1434 may obtain more stable channel information. A multipath signal power and phase information collector 1435 stores the phase and the power of the multipath component obtained by the coherent accumulator 1434.

[38] The channel matching filter unit 144 performs a reverse channel function from the channel information obtained by the adaptive channel estimating unit 143 to cancel an interference signal.

[39] Equation 1 shows the sum of multipath fading signals as received signals input to the receiving antenna of the repeater. When a transmitted signal of a base station is denoted by $s(t)$, the input signal $x(t)$ of the receiving antenna of the repeater is given as follows:

[40] Equation 1

[41]

$$x(t) = \alpha_0 e^{j\Phi_0} s(t - T_0) + \alpha_1 e^{j\Phi_1} s(t - T_1) + \dots + \alpha_{N-1} e^{j\Phi_{N-1}} s(t - T_{N-1})$$

[42]

[43] Here, a signal input to the receiving antenna of the repeater has a type of N multipath signals in which an amplitude and a phase of a transmitted signal of the base station are modulated by

[44]

$$\alpha_i (i=0 \dots N-1)$$

[45] and

[46]

$$e^{j\Phi_i} (i=0 \dots N-1)$$

[47] , respectively.

[48] The transmitted signal transmitted to the transmitting antenna of the repeater after it passes the repeater of the present invention is $G \times s(t)$ (here, G denotes gain of the repeater), and both the reverse signal input to the receiving antenna and the multipath signal input from the base station are represented by the transmitted signal $s(t)$ of the base station having an amplitude modulation of

[49]

$$\alpha_i$$

[50] and a phase modulation of

[51]

$$e^{j\Phi_i}$$

[52] .

[53] So, both the multipath component input from the base station and the reverse signal component of the repeater are included in the N multipath signal components of Equation 1.

[54] The multipath searching unit 142 and the adaptive channel estimating unit 143 estimate the power and phase transition of the multipath in Equation 1 and deliver the estimation to the channel matching filter unit 144.

[55] Equations 2 show derivation of a multipath channel function h(t).

[56] Equations 2

[57]

$$x(t) = (\alpha_0 e^{j\Phi_0} \delta(t - T_0) + \dots + \alpha_{N-1} e^{j\Phi_{N-1}} \delta(t - T_{N-1})) * s(t)$$

[58]

$$h(t) = \alpha_0 e^{j\Phi_0} \delta(t - T_0) + \dots + \alpha_{N-1} e^{j\Phi_{N-1}} \delta(t - T_{N-1})$$

[59] Equations 3 represent a response when the received signal

$$x(t)$$

[60] has passed the channel matching filter unit 144 performing the reverse channel function.

[61] Equations 3

[62]

$$y(t) = h^{-1}(t) * x(t) = h^{-1}(t) * h(t) * s(t) = s(t)$$

[63]

$$H^{-1}(f)H(f) = C$$

[64] Here, C denotes a constant.

[65] Accordingly, a filter coefficient of the channel matching filter unit 144 can be obtained by Equations 4.

[66] Equations 4

[67]

$$H(f)=FFT(h(t))$$

[68]

$$H^{-1}(f)=C/H(f)$$

[69]

$$h^{-1}(t)=IFFT(H^{-1}(f))$$

[70] FIG. 4 is a block diagram illustrating a control circuit of a channel matching filter unit in accordance with an exemplary embodiment of the present invention.

[71] As shown in FIG. 4, a Fast Fourier Transform (FFT) unit 1441 performs a FFT on the multipath channel value obtained by the adaptive channel estimating unit 143 to obtain a frequency response characteristic. A reverse channel frequency response calculator 1442 obtains a frequency response of a reverse channel function so as to make the product of a reverse channel frequency transfer function and the frequency response value of the channel obtained by the FFT unit 1441 a constant. An Inverse FFT (IFFT) unit 1443 transforms the frequency response of the reverse channel function into a value in the time domain and then sets the value as a tap coefficient of the channel matching filter unit 144. A filter coefficient memory 1444 stores the filter coefficient of the reverse channel function obtained by the IFFT unit 1443, and a filter 1445 receives and filters the filter coefficient stored in the filter coefficient memory 1444 to effectively cancel not only the multipath signal received from the base station but the reverse signal component incoming to the receiving antenna from the transmitting antenna of the repeater.

[72] A method of canceling a multipath signal using the apparatus for canceling a multipath signal having the above-described configuration will be described below.

[73] FIG. 5 is a flowchart illustrating a method of canceling a multipath signal in accordance with an exemplary embodiment of the present invention.

[74] As shown in FIG. 5, an initial synchronization procedure of slot synchronization (step 501), frame synchronization and code group synchronization (step 502), and primary scrambling code synchronization (step 503) is performed on the wideband CDMA system. Then, it is determined whether the initial synchronization is successfully completed (step 504), and the process moves to a multipath searching step (505) when the initial synchronization is successfully completed and moves back to the slot synchronization (501) when the initial synchronization is not successfully completed.

[75] After the initial synchronization is performed, a multipath signal is searched for (step 505), the multipath signal is determined when it exceeds a threshold (step 506), and a power and a phase of the multipath channel are estimated (step 507). The process

then goes back to the multipath signal searching (step 505) when the power of the multipath signal is not greater than the threshold and moves to reverse channel coefficient calculation (step 509) when it exceeds the threshold.

[76] A reverse channel response for the channel obtained through the multipath channel searching is then calculated (step 509), and a received signal of the repeater is filtered (step 510). The filtered signal is then amplified (step 511) and transmitted (step 512).

[77] Exemplary embodiments of the present invention have been disclosed herein and, although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. Accordingly, it will be understood by those of ordinary skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present invention as set forth in the following claims.

[78]

Industrial Applicability

[79] According to an apparatus and method for canceling an interference signal of a mobile communication repeater of the present invention as described above, not only a reverse signal of the repeater but also a multipath signal received from a base station can be effectively canceled so that a terminal within a service area can be provided with a signal of high quality.

[80]

Claims

- [1] An apparatus for canceling an interference signal in a mobile communication repeater, the apparatus comprising:
a receiving antenna for receiving a base station signal;
a down-converter for down-converting the signal into a baseband or intermediate frequency band signal;
an Analog/Digital (A/D) converter for converting an output signal of the down-converter into a digital signal;
interference canceling means for canceling a multipath signal of a mobile communication system and an interference signal coming back after being transmitted outside;
a Digital/Analog (D/A) converter for converting an output signal of the interference canceling means into an analog signal;
an up-converter for up-converting the analog signal into a Radio Frequency (RF) signal; and
a transmitting antenna for transmitting the RF signal input through the up-converter to a mobile communication terminal,
wherein the interference canceling means comprises:
an initial synchronization unit for acquiring initial synchronization of the mobile communication system;
a multipath searching unit for discriminating a component of a multipath signal input to the receiving antenna;
an adaptive channel estimating unit for measuring an impulse response of a channel from the multipath component;
*a channel matching filter unit for deriving a reverse channel function based on channel information acquired from the adaptive channel estimating unit to filter an interference signal; and
an amplifying unit for amplifying an output of the channel matching filter unit.
- [2] The apparatus according to claim 1, wherein the initial synchronization comprises slot synchronization, frame synchronization and scrambling code searching.
- [3] The apparatus according to claim 1, wherein the multipath searching unit searches for power of the multipath signal by setting a search window determined by the number of taps of the channel matching filter unit from initial slot synchronization and frame synchronization starting positions for acquiring the initial synchronization of the mobile communication system.
- [4] The apparatus according to claim 3, wherein the multipath searching unit

comprises:

a code phase control unit for controlling the code to be shifted and generated at an interval of $1/N$ chip within the search window of searching the multipath component;

a code generator for generating a scrambling code acquired from the initial synchronization unit;

a correlator for calculating a complex correlation between the scrambling code and a received signal;

a coherent accumulator for accumulating the correlation calculated by the correlator on a 256-chip basis;

an incoherent energy accumulator for accumulating the energy of the accumulated correlation by the incoherently determined number; and

a multipath signal discriminating unit for receiving signal energy per each path phase from the incoherent energy accumulator and discriminating a path whose energy exceeds a threshold.

[5] The apparatus according to claim 1, wherein the adaptive channel estimating unit estimates a reverse channel of the repeater and a multipath channel of the base station from the multipath component discriminated by the multipath searching unit.

[6] The apparatus according to claim 5, wherein the adaptive channel estimating unit comprises:

a code phase control unit for controlling code generation in the multipath position discriminated by the multipath searching unit;

a code generator for generating a scrambling code acquired from the initial synchronization unit;

a correlator for calculating a complex correlation between a received signal and the generated scrambling code;

a coherent accumulator for accumulating the correlation calculated by the correlator on a 256-chip basis to obtain a power and a phase of each path; and

a multipath signal power and phase information collector for storing the power and phase of the multipath component obtained by the coherent accumulator.

[7] The apparatus according to claim 1, wherein the channel matching filter unit derives an inverse function of the multipath channel measured by the adaptive channel estimating unit, and filters the signal input through the receiving antenna to cancel the interference signal.

[8] The apparatus according to claim 7, wherein the channel matching filter unit comprises:

a Fast Fourier Transform (FFT) unit for performing FFT on the multipath

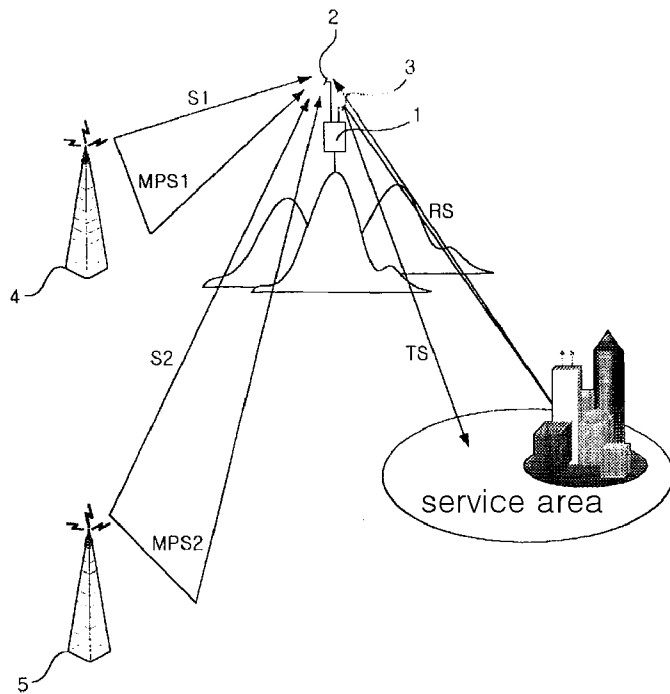
channel value acquired from the adaptive channel estimating unit to obtain a frequency response characteristic;
 a reverse channel frequency response calculator for calculating the frequency response of the reverse channel function so as to make the product of a frequency transfer function of the reverse channel and a frequency response value of the channel obtained by the FFT unit a constant;
 an Inverse FFT (IFFT) unit for transforming the frequency response of the reverse channel into a value in the time domain and setting the value as a tap coefficient of the channel matching filter unit;
 a filter coefficient memory for storing the filter coefficient of the reverse channel function obtained by the IFFT unit; and
 a filter for receiving the stored filter coefficient and filtering a signal received by the receiving antenna

- [9] In a repeater including a receiving antenna for receiving a base station signal, interference canceling means, and a transmitting antenna for transmitting the signal filtered in the interference canceling unit to a mobile communication terminal, the interference canceling means having an initial synchronization unit for acquiring initial synchronization of a mobile communication system, a multipath searching unit for discriminating a multipath signal component of the mobile communication system, an adaptive channel estimating unit for measuring an impulse response of a channel from the multipath component, a channel matching filter unit for filtering an interference signal coming back after being transmitted outside based on channel information successfully completed by the adaptive channel estimating unit, an amplifying unit for amplifying an output of the channel matching filter unit, and a control unit for controlling an interference canceling function, a method of repeating a mobile communication signal comprising the steps of:
- (a) receiving a base station signal at the receiving antenna;
 - (b) acquiring initial synchronization of the mobile communication system at the initial synchronization unit;
 - (c) determining whether the control unit acquires the initial synchronization;
 - (d) searching for the multipath signal at the multipath searching unit;
 - (e) discriminating the multipath signal at the control unit;
 - (f) estimating a power and a phase of the multipath channel at the adaptive channel estimating unit;
 - (g) calculating a reverse channel response for the channel obtained through step (d) and filtering the signal received by the repeater at the channel matching filter unit;

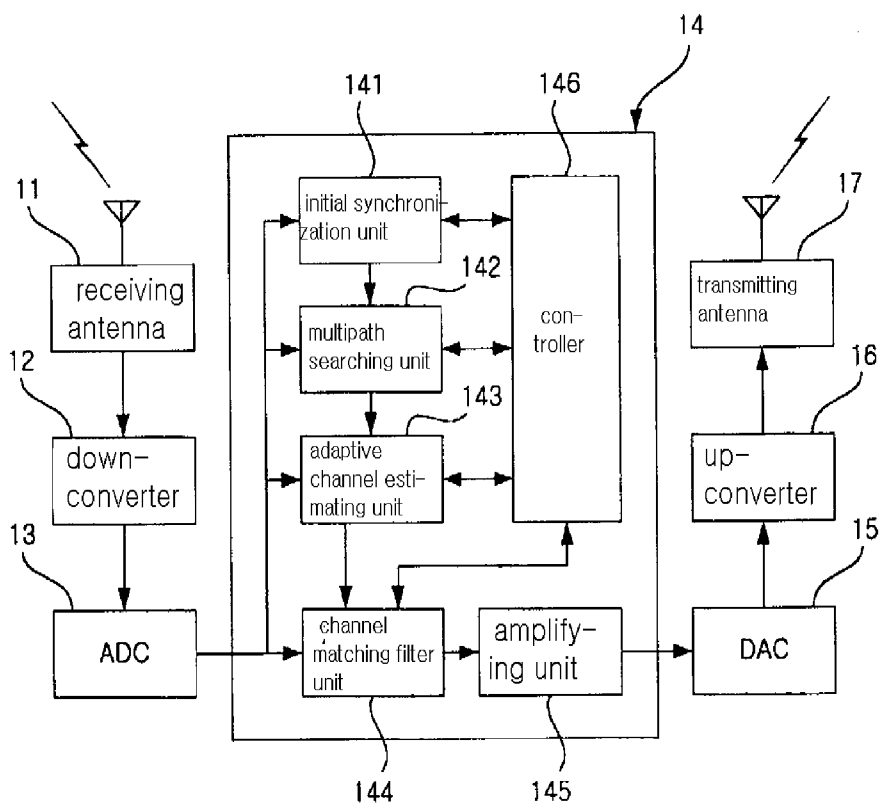
- (h) amplifying the filtered signal at the amplifying unit; and
- (i) transmitting the signal to a service area at the transmit antenna.

[10] The method according to claim 9, wherein step (b) comprises the steps of:
finding a starting point of a slot;
finding a starting point of a frame and a scrambling code group; and
finding a primary scrambling code having the highest correlation from the code group.

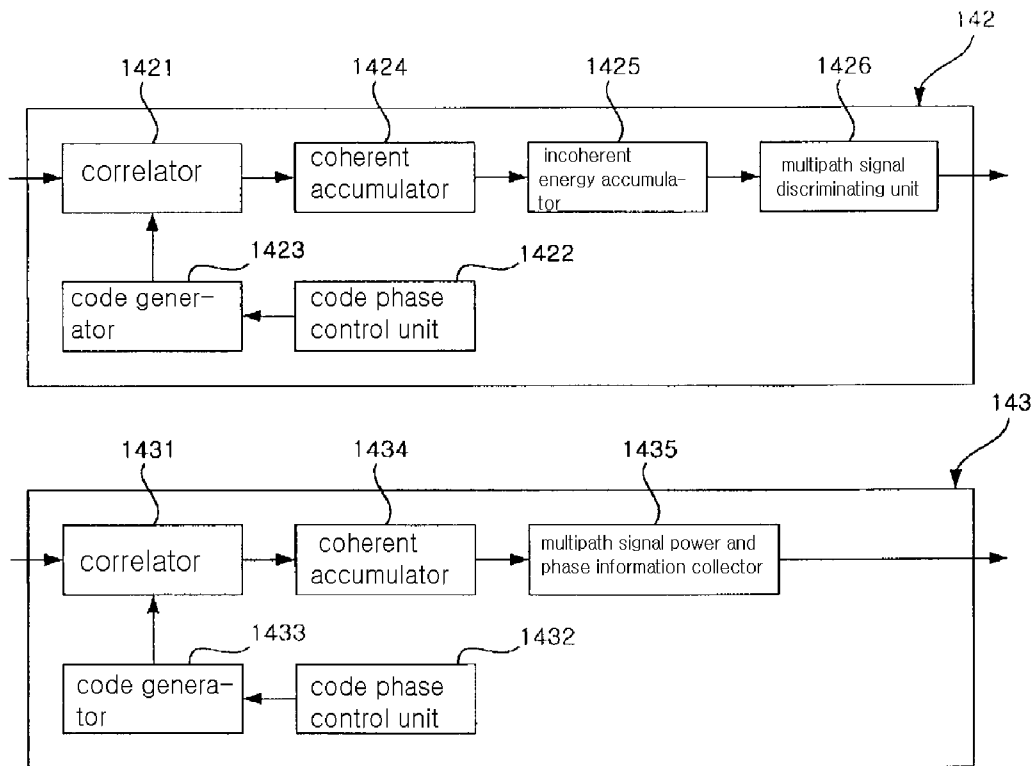
[Fig. 1]



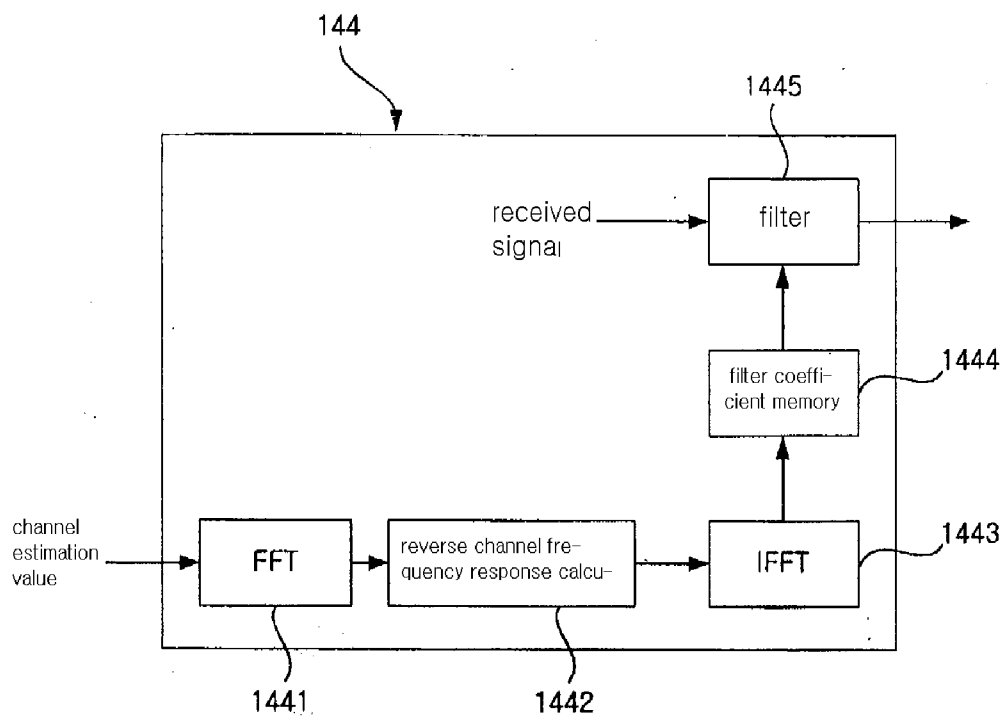
[Fig. 2]



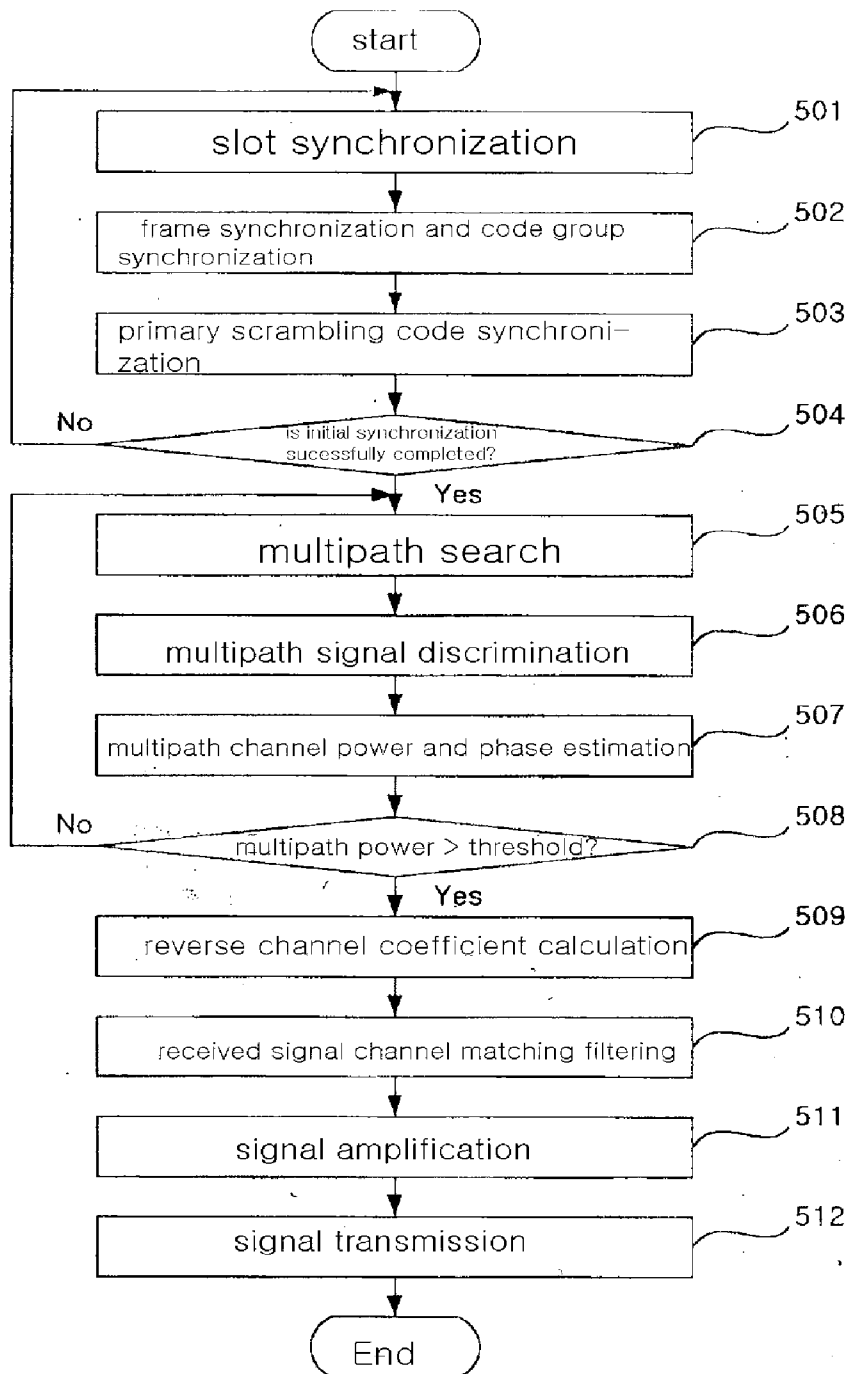
[Fig. 3]



[Fig. 4]



[Fig. 5]



A. CLASSIFICATION OF SUBJECT MATTER**H04B 7/005(2006.01)i, H04B 15/00(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC8 H04B 1/707 7/02 7/005 7/06 7/08 7/26 15/00 17/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility Models since 1975Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) "repeater, interference, multiple path, channel estimation, and similar terms"**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 0211301 A3 (REPEATER TECHNOLOGIES INC.) 30.05.2002. see claims 1,18,32,49,63	1-10
Y	KR2004-0075160 A (NAVUS CO.) 27.08.2004. see claims 1,2,4	1-10
A	US 5652765 B1 (NTT MOBILE COMMUNICATIONS NETWORK INC.) 29.07.1997. see claims 1,2,5,8,12	1-10
A	US 6879625 B1 (GLOBESPANVIRATA INC.) 12.04.2005. see claims 1,2,8,24	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

09 JULY 2007 (09.07.2007)

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2007/001084

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0211301 A3	30.05.2002.	AU 0179086 A5	13.02.2002.
KR 2004-0075160 A	27.08.2004.	None	
US 5652765 B1	29.07.1997.	EP 0668662 A1	23.08.1995.
		WO 9505037 A1	16.02.1995.
US 6879625 B1	12.04.2005.	None	