

CLAIMS

1. A transmission method comprising:

generating a coded block made up of a plurality of bits by using a predetermined error correction block coding scheme;

generating, for each of a plurality of slots, a first transmission signal z1 and a second transmission signal z2 from the coded block; and

transmitting the first transmission signal z1 and the second transmission signal z2 respectively from a first antenna and a second antenna at the same time at the same frequency,

the transmission signal generation including:

generating, for each of the plurality of slots, a first modulated signal s1 and a second modulated signal s2 from the coded block;

with respect to the first modulated signal s1 and the second modulated signal s2, applying precoding expressed by a fixed matrix F and performing a phase change while regularly varying a scheme of phase change for each of the plurality of slots,

the matrix F being expressed as:

$$F = \frac{1}{\sqrt{\alpha^2 + 1}} \begin{pmatrix} e^{j0} & \alpha \times e^{j0} \\ \alpha \times e^{j0} & e^{j\pi} \end{pmatrix}$$

in the coding, a first coded block and a second coded block different from the first coded block being generated as the coded block, and

a scheme of phase change selected for the first slot in the transmission signal generation targeted for the first coded block being the same as a scheme of phase change selected for the first slot in the transmission signal generation targeted for the second coded block.

2. A transmission apparatus comprising:

a coding unit generating a coded block made up of a plurality of bits by using a predetermined error correction block coding scheme;

a transmission signal generating unit generating, for each of a plurality of slots, a first transmission signal z1 and a second transmission signal z2 from the coded block; and

a transmitting unit transmitting the first transmission signal z1 and the second transmission signal z2 respectively from a first antenna and a second antenna at the same time at the same frequency,

the transmission signal generating unit including:

a modulated signal generating unit generating a first modulated signal s1 and a second modulated signal s2 from the coded block;

a precoding unit applying precoding expressed by a fixed matrix F; and

a phase changing unit performing a phase change while regularly varying a scheme of phase change for each of the plurality of slots,

the precoding and the phase change being performed with respect to the first modulated signal s1 and the second modulated signal s2,

the matrix F being expressed as:

$$F = \frac{1}{\sqrt{\alpha^2 + 1}} \begin{pmatrix} e^{j0} & \alpha \times e^{j0} \\ \alpha \times e^{j0} & e^{j\pi} \end{pmatrix}$$

the coding unit generates, as the coded block, a first coded block and a second coded block different from the first coded block, and

a scheme of phase change selected for the first slot in the transmission signal generation by the transmission signal generating unit targeted for the first coded block being the same as a scheme of phase change selected for the first slot in the transmission signal generation by the transmission signal generating unit targeted for the second coded block.

3. A reception method comprising:

acquiring a reception signal obtained by receiving a first transmission signal z1 and a second transmission signal z2 respectively transmitted from a first antenna and a second antenna at the same time at the same frequency, the first transmission signal z1 and the second transmission signal z2 having been generated by a predetermined generation process; and

obtaining reception data by applying a demodulation process corresponding to the predetermined generation process to the reception signal,

the predetermined generation process

being a process to generate, for each of a plurality of slots, the first transmission signal z1 and the second transmission signal z2 from a coded block having been generated by using a predetermined error correction block coding scheme and made up of a plurality of bits, and

including:

generating, for each of the plurality of slots, a first modulated signal s1 and a second modulated signal s2 from the coded block;

with respect to the first modulated signal s1 and the second modulated signal s2, applying precoding expressed by a fixed matrix F and performing a phase change while regularly varying a scheme of phase change for each of the plurality of slots,

the matrix F being expressed as:

$$F = \frac{1}{\sqrt{\alpha^2 + 1}} \begin{pmatrix} e^{j0} & \alpha \times e^{j0} \\ \alpha \times e^{j0} & e^{j\pi} \end{pmatrix}$$

in the coding, a first coded block and a second coded block different from the first coded block being generated as the coded block, and

a scheme of phase change selected for the first slot in the transmission signal generation targeted for the first coded block being the same as a scheme of phase change selected for the first slot in the transmission signal generation targeted for the second coded block.

4. A reception apparatus comprising:

an acquiring unit acquiring a reception signal obtained by receiving a first transmission signal z1 and a second transmission signal z2 respectively transmitted from a first antenna and a second antenna at the same time at the same frequency, the first transmission signal z1 and the second transmission signal z2 having been generated by a predetermined generation process; and

a demodulating unit obtaining reception data by applying a demodulation process corresponding to the predetermined generation process to the reception signal,

the predetermined generation process

being a process to generate, for each of a plurality of slots, the first transmission signal z1 and the second transmission signal z2 from a coded block having been generated by using a predetermined error correction block coding scheme and made up of a plurality of bits, and

including:

generating, for each of the plurality of slots, a first modulated signal s1 and a second modulated signal s2 from the coded block;

with respect to the first modulated signal s1 and the second modulated signal s2, applying precoding expressed by a fixed matrix F and performing a phase change while regularly varying a scheme of phase change for each of the plurality of slots,

the matrix F being expressed as:

$$F = \frac{1}{\sqrt{\alpha^2 + 1}} \begin{pmatrix} e^{j0} & \alpha \times e^{j0} \\ \alpha \times e^{j0} & e^{j\pi} \end{pmatrix}$$

in the coding, a first coded block and a second coded block different from the first coded block being generated as the coded block, and

a scheme of phase change selected for the first slot in the transmission signal generation targeted for the first coded block being the same as a scheme of phase change selected for the first slot in the transmission signal generation targeted for the second coded block.

CLAIMS

1. A signal generation method for generating, from a plurality of baseband signals, a plurality of signals for transmission on a common frequency band and at a common time, comprising the steps of:

5 generating M first encoded blocks usable as a first set of bits and M second encoded blocks usable as a second set of bits using a predetermined error-correcting block coding method, where M is a natural number;

 performing a change of phase on each of a first baseband signal s1 generated from the first set of bits and a second baseband signal s2 generated from
10 the second set of bits, thus generating a first post-phase change baseband signal s1' and a second post-phase change baseband signal s2', each including M symbols; and

 applying weighting to the first post-phase change baseband signal s1' and to the second post-phase change baseband signal s2' according to a predetermined matrix F, thus generating the plurality of signals for transmission on the common
15 frequency band and at the common time as a combination of M pairs of a first weighted signal z1 and a second weighted signal z2, wherein

 the first weighted signal z1 and the second weighted signal z2 satisfy the relation:

$$(z1, z2)^T = F(s1', s2')^T$$

20 and the change of phase is performed on the first baseband signal s1 and the second baseband signal s2 using a phase modification value sequentially selected from among N phase modification value candidates.

2. A signal generation apparatus for generating, from a plurality of baseband signals,
25 a plurality of signals for transmission on a common frequency band and at a common time, comprising:

 an encoder generating M first encoded blocks usable as a first set of bits and M second encoded blocks usable as a second set of bits using a predetermined

~~error-correcting block coding method, where M is a natural number;~~

a phase changer performing a change of phase on each of a first baseband signal s1 generated from the first set of bits and a second baseband signal s2 generated from the second set of bits, thus generating a first post-phase change
5 baseband signal s1' and a second post-phase change baseband signal s2', each including M symbols; and

a weighting unit applying weighting to the first post-phase change baseband signal s1' and to the second post-phase change baseband signal s2' according to a predetermined matrix F, thus generating the plurality of signals for transmission on
10 the common frequency band and at the common time as a combination of M pairs of a first weighted signal z1 and a second weighted signal z2, wherein

the first weighted signal z1 and the second weighted signal z2 satisfy the relation:

$$(z1, z2)^T = F(s1', s2')^T$$

15 and the change of phase is performed on the first baseband signal s1 and the second baseband signal s2 using a phase modification value sequentially selected from among N phase modification value candidates.