- f is the usage frequency of the array antenna,
- $\overrightarrow{K_p}$ is a vector comprising the direction of each of the *P* side lobes generated by the differences between radiating panels,
- $\left(r^{\langle n \rangle}\right)_m$ is the position of the radiating element *m* of the radiating panel *n* in the reference frame of the array antenna,
- $\overrightarrow{(r_r^{\langle n \rangle})_m}$ is the position of each radiating element actually realized and expressed in an overall reference frame,
- $f\left(\vec{k}\right)_{n,m}$ is the elementary pattern of the radiating element *n, m*.

[0058] The first term of the equation, in $W_c\left[\overrightarrow{K_p}, \overrightarrow{(r^{\langle n \rangle})_m}\right]$, corresponds to the *P* shaping coefficients ω_c that have to be applied to each of the radiating elements to point the beam from the array antenna in each of the *P* directions $\overrightarrow{K_p}$ of the side lobes of the antenna, when a control law is considered that takes account of all of the array antenna i.e.

$$W_c\left[\overrightarrow{K_p}, \overrightarrow{(r^{\langle n \rangle})_m}\right] = \left[\left[\omega_c\left[\overrightarrow{K_p}, \overrightarrow{(r^{\langle 1 \rangle})_m}\right]_{1..M}\right]^{\langle 1 \rangle} \ldots \left[\omega_c\left[\overrightarrow{K_p}, \overrightarrow{(r^{\langle N \rangle})_m}\right]_{1..M}\right]^{\langle N \rangle}\right].$$

[0059] For each direction $\overrightarrow{K_p}$, the corresponding shaping coefficient ω_c is obtained from the associated control law that makes it possible to point the beam from the array antenna in the direction of the side lobe considered, at the desired level. It is therefore a complex amplitude/phase coefficient.

[0060] The second term of the equation, in $W_{co}\left[\overrightarrow{k_0}, \overrightarrow{(r^{\langle n \rangle})_m}\right]$, corresponds to the control law to be applied to the various antenna elements to point the beam from the array antenna in the desired direction, when a control law is considered that takes account of all of the array antenna. Then:

$$W_{co}\left[\overrightarrow{k_0}, \overrightarrow{(r^{\langle n \rangle})_m}\right] = \left[\left[\omega_{co}\left[\overrightarrow{k_0}, \overrightarrow{(r^{\langle 1 \rangle})_m}\right]_{1..M}\right]^{\langle 1 \rangle} \ldots \left[\omega_{co}\left[\overrightarrow{k_0}, \overrightarrow{(r^{\langle N \rangle})_m}\right]_{1..M}\right]^{\langle N \rangle}\right],$$

with:

- ω_{co} the shaping coefficient corresponding to the targeted direction.

[0061] The coefficient ω_{co} can therefore correspond to a phase-shift only, or advantageously be a complex amplitude/phase coefficient.

[0062] The third term of the equation, in $W\left[\vec{k}, \overrightarrow{(r_r^{\langle n \rangle})_m}\right]$, corresponds to the phase factor of the signal picked up by each radiating element to take account of the interferences between the radiating elements. This phase factor can contain a calibration coefficient generally obtained in a calibration phase performed during the manufacture of each radiating panel.

[0063] The fourth term of the equation, in $f(\vec{k})_{n,m}$, represents the elementary pattern of the radiating element n,m. It makes it possible to take account of the slight differences that may exist between the patterns of the various radiating elements, and therefore the effects of mutual couplings between radiating elements. It can be expressed as:

$$f(\vec{k})_{n,m} = E_{inc}\left[Mr_n\left(\overrightarrow{h(\vec{k},f)}\right)_{n,m}\right]$$

with:

- E_{inc} the polarization of an incident planar wave,
- Mr_n a rotation matrix associated with the radiating element n.

[0064] To reduce the side lobes due to the presence of differences between the various radiating panels, the invention proposes applying to each of the radiating elements a complex shaping coefficient calculated on the principle of the subtraction in the known direction of each of the spurious lobes of a lobe of equivalent level equal to that of the spurious lobe. The knowledge of the spurious lobe is determined by the knowledge of the position of the elements of the overall array installed on its site of use. The coefficient of a radiating element is equal to the coefficient ω_{co}, required to orient the maximum gain of the antenna in a given direction, minus the coefficients ω_c corresponding to the directions of the side lobes affected by the levels of the spurious side lobes. That way, the effect of the gaps between radiating panels is compensated and the level of the side lobes is reduced.

CLAIMS

1. An array antenna, characterized in that it comprises:
   - a plurality of mechanically separate radiating panels (300-1, 300-N) arranged side-by-side, each radiating panel comprising a plurality of radiating elements (301-1, 30M-1, 301-N, 30M-N),
   - means (351-1, 35M-1, 351-N, 35M-N) for applying a shaping to radio frequency signals transmitted by or received from each radiating element, and
   - a device (361) for managing the radio frequency signal shaping application means,

   wherein the shaping application means are configured to apply, to the signal transmitted by or received from each radiating element, a complex shaping coefficient corresponding to a sum of at least:
   - a shaping coefficient W_{co} making it possible to orient the maximum gain of the antenna in a desired pointing direction, and
   - at least the opposite of a shaping coefficient W_c making it possible to orient the maximum gain of the antenna in the direction of a side lobe resulting from gaps and alignment differences between the radiating panels of the array antenna.

2. The array antenna as claimed in one of the preceding claims, wherein the sum used to calculate the complex shaping coefficient applied to the radiating elements further comprises a calibration coefficient W.

3. The array antenna as claimed in one of the preceding claims, wherein the shaping coefficient W_{co} making it possible to orient the maximum gain of the antenna in a desired pointing direction is calculated from the desired pointing direction of the array antenna, from the frequency of the radio frequency signal, from the position of the radiating element considered within the array antenna, and from the total number of radiating elements of the array antenna.

4. The array antenna as claimed in one of the preceding claims, wherein the shaping coefficient W_c making it possible to orient the maximum gain of the antenna in the direction of at least one side lobe resulting from gaps and alignment differences between the radiating panels of the array antenna is calculated from the direction of said side lobe, from the frequency of the radio frequency signal, from the position of the radiating element considered within the array antenna, and from the total number of radiating elements of the array antenna.

5. The array antenna as claimed in one of the preceding claims, used to receive the radio frequency signal, further comprising means (362-1, 362-N, 381) for summing the signals received from each of the radiating elements and shaped.

6. A method for the transmission or reception of a radio frequency signal for an array antenna comprising a plurality of radiating panels (300-1, 300-N) arranged side-by-side, each radiating panel comprising a plurality of radiating elements (301-1, 30M-1, 301-N, 30M-N), the method comprising the application (603) of a complex shaping coefficient (711) to the signal transmitted by or received from each radiating element, characterized in that said shaping coefficient corresponds to a sum of at least:
    - a shaping coefficient W_{co} (707) making it possible to orient the maximum gain of the array antenna in a desired pointing direction, and
    - at least the opposite of a shaping coefficient W_c (708) making it possible to orient the maximum gain of the antenna in the direction of a side lobe resulting from gaps and alignment differences between the radiating panels of the array antenna.

7. The method for the transmission or reception of the radio frequency signal as claimed in the preceding claim, characterized in that it further comprises a preliminary step (602) of characterization of side lobes resulting from gaps and alignment differences between the radiating panels of the array antenna.