CLAIMS

1. A method for creating two beams, a first beam and a second beam, the method comprising:

using an antenna array to create said first beam and said second beam, wherein

the antenna array comprises: a first antenna element (AE1-a) and a second antenna element (AE1-b) that together form a pair of antenna elements (AE1-a,AE1-b), the first antenna element (AE1-a) comprises an antenna element port (S_{1a}) connected to a first antenna (A1) and the second antenna element (AE1-b) comprises an antenna element port (T_{1b}) connected to a second antenna (A2); **characterized in** that

the first antenna (A1) has a first polarization and that the second antenna (A2) has a second polarization, where the first polarization is orthogonal or substantially orthogonal to the second polarization, and the first antenna (A1) and the second antenna (A2) have the same or substantially the same power pattern, where the step of using the antenna array to create said first beam and said second beam comprises:

applying beam weights $W_{b1,S1a}$ and $W_{b2,S1a}$ to antenna element port S_{1a}; and

applying beam weights $W_{b1,T1b}$ and $W_{b2,T1b}$ to antenna element port T_{1b}, wherein

~~$W_{b2,S1a}$ is a function of $W_{b1,T1b}$, and~~

~~$W_{b2,T1b}$ is a function of $W_{b1,S1a}$.~~

~~2. The method of claim 1, wherein~~

$W_{b2,S1a}$ is a function of the complex conjugate of $W_{b1,T1b}$, and

$W_{b2,T1b}$ is a function of the complex conjugate of $W_{b1,S1a}$.

~~3. The method of claim 2, further comprising determining $W_{b2,S1a}$, wherein~~

~~the step of determining $W_{b2,S1a}$ includes (a) phase shifting the complex conjugate of $W_{b1,T1b}$ or (b) multiplying the complex conjugate of $W_{b1,T1b}$ by amplitude scaling factor, thereby producing an amplitude scaled complex conjugate of $W_{b1,T1b}$, and phase shifting the amplitude scaled complex conjugate of $W_{b1,T1b}$.~~

~~4. The method of claim 3, wherein~~

~~the step of determining $W_{b2,S1a}$ includes phase shifting the complex conjugate of $W_{b1,T1b}$ and multiplying the phase shifted complex conjugate of $W_{b1,T1b}$ by the amplitude scaling factor.~~

~~5. The method of claim 4, wherein the step of phase shifting comprises phase shifting by pi.~~

~~6. The method of claim 1, whereinsuch that~~

$W_{b2,S1a}$ equals or substantially equals $e^{i(\beta+\pi)}(W_{b1,T1b})^* \alpha_1$, and

$W_{b2,T1b}$ equals or substantially equals $e^{i\beta}(W_{b1,S1a})^* 1/\alpha_1$,

where $(W_{b1,S1a})^*$ is the complex conjugate of $W_{b1,S1a}$ and $(W_{b1,T1b})^*$ is the complex conjugate of $W_{b1,T1b}$, α_1 is an amplitude scaling factor and β is a phase shift.

2~~7~~. The method of claim 1~~6~~, wherein $\alpha_1 = 1$ and $\beta = 0$.

3~~8~~. The method of claim 1~~6~~, wherein α_1 is a function the power of a signal emitted by the first antenna and the power of a signal emitted by the second antenna.

4~~9~~. The method of claim 1, wherein

the first antenna element (AE1-a) comprises a second antenna element port (T_{1a}) connected to a third antenna (A3) having a polarization and a power pattern;

the second antenna element (AE1-b) comprises a second antenna element port (S_{1b}) connected to a fourth antenna (A4) having a polarization and a power pattern, and

the step of using the antenna array to create said first beam and said second beam further comprises:

applying beam weights $W_{b1,T1a}$ and $W_{b2,T1a}$ to antenna element port T_{1a}; and

applying beam weights $W_{b1,S1b}$ and $W_{b2,S1b}$ to antenna element port S_{1b}, wherein

$W_{b2,S1b}$ is a function of the complex conjugate of $W_{b1,T1a}$, and

$W_{b2,T1a}$ is a function of the complex conjugate of $W_{b1,S1b}$.

5~~10~~. The method of claim 4~~9~~, further comprising

determining $W_{b2,S1b}$; and

determining $W_{b2,T1a}$, wherein

the step of determining $W_{b2,S1b}$ comprises (a) phase shifting the complex conjugate of $W_{b1,T1a}$ or (b) multiplying the complex conjugate of $W_{b1,T1a}$ by an amplitude scaling factor, thereby producing an amplitude scaled complex conjugate of $W_{b1,T1a}$, and phase shifting the amplitude scaled complex conjugate of $W_{b1,T1a}$, and

the step of determining $W_{b2,T1a}$ comprises determining the complex conjugate of $W_{b1,S1b}$.

611. The method of claim 49, wherein

the polarization of the first antenna (A1) is orthogonal or substantially orthogonal to the polarization of the third antenna (A3),

the polarization of the fourth antenna (A4) is orthogonal or substantially orthogonal to the polarization of the second antenna (A2), and

the third antenna (A3) and the fourth antenna (A4) have the same or substantially the same power pattern.

712. The method of claim 1, wherein

the antenna array further comprises a third antenna element (AE2-a) and a fourth antenna element (AE2-b) that together form a second pair of antenna elements (AE2-a,AE2-b), wherein the third antenna element (AE2-a) comprises an antenna element port (S_{2a}) connected to a fifth antenna (A5) and the fourth antenna element (AE2-b) comprises an antenna element port (T_{2b}) connected to a sixth antenna (A6), and

the step of using the antenna array to create said first beam and said second beam further comprises:

applying beam weights $W_{b1,S2a}$ and $W_{b2,S2a}$ to antenna element port S_{2a}; and

applying beam weights $W_{b1,T2b}$ and $W_{b2,T2b}$ to antenna element port T_{2b}, wherein

$W_{b2,S2a}$ is a function of the complex conjugate of $W_{b1,T2b}$ phase shifted by pi + β; and

$W_{b2,T2b}$ is a function of the complex conjugate of $W_{b1,S2a}$ phase shifted by β.

813. The method of claim 712, wherein the antenna array is a 2-dimensional antenna array.

914. The method of claim 712, wherein

the first antenna element and the second antenna element are located symmetrically with respect to a symmetry point for the antenna array, and

the third antenna element and the fourth antenna element are located symmetrically with respect to the symmetry point.

105. The method of claim 1, wherein (a) the shape of the power beam pattern for the first beam and the shape of the power beam pattern for the second beam are the same or substantially the same in a plurality of directions of interest and (b) the first beam and the second beam have orthogonal or substantially orthogonal polarizations in the coverage area.

116. An antenna array apparatus, comprising:

a first antenna element comprising a first antenna (A1) and an antenna element port (S_{1a}) connected to the first antenna (A1); and

a second antenna element comprising a second antenna (A2) and an antenna element port (T_{1b}) connected to the second antenna (A2),

characterized in that the first antenna (A1) has a first polarization and that the second antenna (A2) has a second polarization, where the first polarization is orthogonal or substantially orthogonal to the second polarization, and the first antenna (A1) and the second antenna (A2) have the same or substantially the same power pattern, where the antenna array apparatus further comprises:

a first beam forming circuit configured to apply beam weights $W_{b1,S1a}$ and $W_{b2,S1a}$ to port S_{1a}; and

a second beam forming circuit configured to apply beam weights $W_{b1,T1b}$ and $W_{b2,T1b}$ to port T_{1b}, wherein

~~$W_{b2,S1a}$ is a function of $W_{b1,T1b}$, and~~

~~$W_{b2,T1b}$ is a function of $W_{b1,S1a}$.~~

~~17. The antenna array of claim 16, wherein~~

$W_{b2,S1a}$ is a function of the complex conjugate of $W_{b1,T1b}$, and

$W_{b2,T1b}$ is a function of the complex conjugate of $W_{b1,S1a}$.

~~18. The antenna array of claim 17, further comprising a weight determining unit configured to determine $W_{b2,S1a}$ and $W_{b2,T1b}$, wherein~~

~~the weight determining unit is configured to determine $W_{b2,S1a}$ by obtaining the complex conjugate of $W_{b1,T1b}$ and (a) phase shifting the complex conjugate of $W_{b1,T1b}$ or (b) multiplying the complex conjugate of $W_{b1,T1b}$ by an amplitude scaling factor, thereby producing an amplitude scaled complex conjugate of $W_{b1,T1b}$, and phase shifting the amplitude scaled complex conjugate of $W_{b1,T1b}$, and~~

~~the weight determining unit is configured to determine $W_{b2,T1b}$ by obtaining the complex conjugate of $W_{b1,S1a}$.~~

~~19. The antenna array of claim 18, wherein~~

~~the weight determining unit is configured to determine $W_{b2,S1a}$ by phase shifting the obtained complex conjugate of $W_{b1,T1b}$, thereby producing a phase shifted complex conjugate of $W_{b1,T1b}$, and multiplying the phase shifted complex conjugate of $W_{b1,T1b}$ by the amplitude scaling factor.~~

~~20. The antenna array of claim 19, wherein the weight determining unit is configured to phase shift the complex conjugate of $W_{b1,T1b}$ by phase shifting the complex conjugate of $W_{b1,T1b}$ by pi.~~

~~21. The antenna array of claim 16, wherein~~such that

$W_{b2,S1a}$ equals or substantially equals $e^{i(\beta+\pi)}(W_{b1,T1b})^* \alpha_1$, and

$W_{b2,T1b}$ equals or substantially equals $e^{i\beta}(W_{b1,S1a})^* 1/\alpha_1$,

where $(W_{b1,S1a})^*$ is the complex conjugate of $W_{b1,S1a}$ and $(W_{b1,T1b})^*$ is the complex conjugate of $W_{b1,T1b}$, α_1 is an amplitude scaling factor and β is a phase shift.