

CLAIMS

What is claimed is:

1. A method for attenuating sources of interference during wireless communication between an airborne platform and a surface base station, the method comprising:
 - forming a directional beam towards a base station, wherein the directional beam is spatially oriented signal propagation originating from the airborne platform, and wherein the directional beam receives a signal from the surface base station;
 - identifying at least one source of interference; and
 - forming at least one null to substantially attenuate the at least one source of interference.
2. The method as recited in claim 1, wherein the at least one null is formed to substantially reduce the signal to interference ratio.
3. The method as recited in claim 1, wherein the at least one null is generated utilizing the airborne platform.
4. The method as recited in claim 3, wherein the at least one null is formed substantially below the airborne platform.
5. The method as recited in claim 1, further comprising modulating the formed at least one null over time, utilizing a time tail, in order to reduce the signal to interference ratio.

6. The method as recited in claim 1, further comprising:
- generating a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; and
 - receiving a response to at least one of the plurality of generated directional synchronization beams thereby determining direction of a base station from the response.
7. The method as recited in claim 6, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.
8. The method as recited in claim 6, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams sequentially.
9. The method as recited in claim 6, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.
10. The method as recited in claim 1, further comprising:
- receiving a training beam including a known data;
 - generating weights from the received known data;
 - utilizing the generated weights to modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.

11. The method as recited in claim 10, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.
12. A system for wireless communication between an airborne platform and a surface base station, the system comprising:
- an antenna array at an airborne platform configured to:
 - generate a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; and
 - receive a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of a base station from the response
 - receive a training beam including a known data;
 - generate weights from the received known data;
 - form a directional beam towards a base station, wherein the directional beam is spatially oriented signal propagation originating from the airborne platform, and wherein the directional beam receives signals from the surface base station; and wherein the directional beam is formed using a modified base signal, and wherein the modifying the base signal includes modifying at least one of phase and amplitude using the generated weights;
 - identify at least one source of interference by flagging all radiating sources, identifying at least one inbound beamform, removing the radiating sources which are generating the at least one inbound beamform from the flagged radiating sources, and setting remaining flagged radiating sources as interference sources; and
 - form at least one null to substantially attenuate the at least one source of interference.

13. A method for synchronizing wireless communication between an airborne platform and a surface base station, the method comprising:

generating a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; and

receiving a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of a base station from the response.

14. The method as recited in claim 13, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.

15. The method as recited in claim 13, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams in series.

16. The method as recited in claim 13, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.

17. A method for training wireless communication between an airborne platform and a surface base station, the method comprising:

receiving a training beam including a known data;

generating weights from the received known data;

utilizing the generated weights to modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.

18. The method as recited in claim 17, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.

19. A method for attenuating sources of interference during wireless communication between a surface platform and a base station, the method comprising:

forming a directional beam towards a base station, wherein the directional beam is spatially oriented signal propagation originating from a surface platform, and wherein the surface platform receives a signal from the base station;

identifying at least one source of interference; and

forming at least one null to substantially attenuate the at least one source of interference.

20. The method as recited in claim 19, wherein the at least one null is formed to substantially reduce the signal to interference ratio.

21. The method as recited in claim 19, wherein the at least one null is generated utilizing the surface platform.

22. The method as recited in claim 19, further comprising modulating the formed at least one null over time, utilizing a time tail, in order to reduce the signal to interference ratio.

23. The method as recited in claim 19, further comprising:

generating a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; and

receiving a response to at least one of the plurality of generated directional synchronization beams thereby determining direction of the base station from the response.

24. The method as recited in claim 23, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.

25. The method as recited in claim 23, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams sequentially.

26. The method as recited in claim 23, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.

27. The method as recited in claim 19, further comprising:
receiving a training beam including a known data;
generating weights from the received known data;
utilizing the generated weights to modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.

28. The method as recited in claim 27, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.

29. A system for wireless communication between a surface platform and a base station, the system comprising:

an antenna array at a surface platform configured to:

generate a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; and

receive a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of the base station from the response

receive a training beam including a known data;

generate weights from the received known data;

form a directional beam towards the base station, wherein the directional beam is spatially oriented signal propagation originating from the surface platform, and wherein the directional beam receives signals from the base station; and wherein the directional beam is formed using a modified base signal, and wherein the modifying the base signal includes modifying at least one of phase and amplitude using the generated weights;

identify at least one source of interference by flagging all radiating sources, identifying at least one inbound beamform, removing the radiating sources which are generating the at least one inbound beamform from the flagged radiating sources, and setting remaining flagged radiating sources as interference sources; and

form at least one null to substantially attenuate the at least one source of interference.

30. A method for synchronizing wireless communication between a surface platform and a base station, the method comprising:

generating a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; and

receiving a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of a base station from the response.

31. The method as recited in claim 30, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.

32. The method as recited in claim 30, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams in series.

33. The method as recited in claim 30, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.

34. A method for training wireless communication between a surface platform and a base station, the method comprising:

receiving a training beam including a known data;

generating weights from the received known data;

utilizing the generated weights to modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.

35. The method as recited in claim 34, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.

What is claimed is:

1. A system for wireless communication between an airborne platform and a surface base station, the system comprising: an antenna array at an airborne platform configured to: generate a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; receive a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of a base station from the response; receive a training beam including a known data; generate weights from the received known data; form a directional beam towards a base station, wherein the directional beam is spatially oriented signal propagation originating from the airborne platform, and wherein the directional beam receives signals from the surface base station; and wherein the directional beam is formed using a modified base signal, and wherein the modifying the base signal includes modifying at least one of phase and amplitude using the generated weights; identify at least one source of interference by flagging all radiating sources, identifying at least one inbound beamform, removing the radiating sources which are generating the at least one inbound beamform from the flagged radiating sources, and setting remaining flagged radiating sources as interference sources; and form at least one null to substantially attenuate the at least one source of interference.
2. The system as recited in claim 1, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.
3. The system as recited in claim 1, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams in series.
4. The system as recited in claim 1, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.
5. The system as recited in claim 1, wherein the generated weights modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.
6. The system as recited in claim 1, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.

7. The system as recited in claim 1, wherein the at least one null is formed to substantially reduce the signal to interference ratio.
8. The system as recited in claim 1, wherein the at least one null is generated utilizing the surface platform.
9. The system as recited in claim 1, wherein the formed at least one null is modulated over time, utilizing a time tail, in order to reduce the signal to interference ratio.
10. The system as recited in claim 1, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams sequentially.
11. A system for wireless communication between a surface platform and a base station, the system comprising: an antenna array at a surface platform configured to: generate a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; receive a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of the base station from the response; receive a training beam including a known data; generate weights from the received known data; form a directional beam towards the base station, wherein the directional beam is spatially oriented signal propagation originating from the surface platform, and wherein the directional beam receives signals from the base station; and wherein the directional beam is formed using a modified base signal, and wherein the modifying the base signal includes modifying at least one of phase and amplitude using the generated weights; identify at least one source of interference by flagging all radiating sources, identifying at least one inbound beamform, removing the radiating sources which are generating the at least one inbound beamform from the flagged radiating sources, and setting remaining flagged radiating sources as interference sources; and form at least one null to substantially attenuate the at least one source of interference.
12. The system as recited in claim 11, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.
13. The system as recited in claim 11, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams in series.

14. The system as recited in claim 11, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.
15. The system as recited in claim 11, wherein the generated weights modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.
16. The system as recited in claim 11, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.
17. The system as recited in claim 11, wherein the at least one null is formed to substantially reduce the signal to interference ratio.
18. The system as recited in claim 11, wherein the at least one null is generated utilizing the surface platform.
19. The system as recited in claim 11, wherein the formed at least one null is modulated over time, utilizing a time tail, in order to reduce the signal to interference ratio.
20. The system as recited in claim 11, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams sequentially.
21. A method for attenuating sources of interference during wireless communication between an airborne platform and a surface base station, the method comprising: generating a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; receiving a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of a base station from the response; receiving a training beam including a known data; generating weights from the received known data; forming a directional beam towards a base station, wherein the directional beam is spatially oriented signal propagation originating from the airborne platform, and wherein the directional beam receives signals from the surface base station; and wherein the directional beam is formed using a modified base signal, and wherein the modifying the base signal includes modifying at least one of phase and amplitude

using the generated weights; identifying at least one source of interference by flagging all radiating sources, identifying at least one inbound beamform, removing the radiating sources which are generating the at least one inbound beamform from the flagged radiating sources, and setting remaining flagged radiating sources as interference sources; and forming at least one null to substantially attenuate the at least one source of interference.

22. The method as recited in claim 21, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.

23. The method as recited in claim 21, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams in series.

24. The method as recited in claim 21, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.

25. The method as recited in claim 21, further comprising using the generated weights to modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.

26. The method as recited in claim 21, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.

27. The method as recited in claim 21, wherein the at least one null is formed to substantially reduce the signal to interference ratio.

28. A method for attenuating sources of interference during wireless communication between a surface platform and a surface base station, the method comprising: generating a plurality of directional synchronization beams, wherein the plurality of directional synchronization beams are directed in at a plurality of corresponding spatial directions; receiving a response to at least one of the plurality of generated directional synchronization beams thereby determining directionality of a base station from the response; receiving a training beam including a known data; generating weights from the received known data; forming a directional beam towards a base station, wherein the directional beam is spatially oriented signal propagation originating from the surface platform, and wherein the directional beam receives signals from the surface base station; and wherein the directional beam is formed using a modified base signal, and

wherein the modifying the base signal includes modifying at least one of phase and amplitude using the generated weights; identifying at least one source of interference by flagging all radiating sources, identifying at least one inbound beamform, removing the radiating sources which are generating the at least one inbound beamform from the flagged radiating sources, and setting remaining flagged radiating sources as interference sources; and forming at least one null to substantially attenuate the at least one source of interference.

29. The method as recited in claim 28, wherein the directional synchronization beams are generated by introducing at least one of randomized and deterministic perturbations to at least one of phase and amplitude of signal provided to at least one antenna in an antenna array.

30. The method as recited in claim 28, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams in series.

31. The method as recited in claim 28, wherein the generating the plurality of directional synchronization beams includes transmitting the plurality of directional synchronization beams simultaneously.

32. The method as recited in claim 28, further comprising utilizing the generated weights to modify at least one of phase and amplitude of a base signal, and wherein the modifying of the at least one of phase and amplitude determine directionality of the formed directional beam.

33. The method as recited in claim 28, wherein the known data includes a column from at least one of a Walsh, a Golay, a Hadamard, and a Fourier matrix.

34. The method as recited in claim 28, wherein the at least one null is formed to substantially reduce the signal to interference ratio.