

CLAIMS:

1. An antenna system, configured to detect weak electro-magnetic signals, comprising:
 - a. an antenna; and
 - 5 b. a feed manifold, the feed manifold comprising a plurality of feeds located on a focal surface of the antenna,wherein the antenna is configured to function as a two-dimensional focusing element, having spherical symmetry,
wherein the antenna system configured such that a planar wave-front
10 impinging on the antenna, the planar wave-front associated with the least one electro-magnetic signal, is focused by the antenna to a feed of the plurality of feeds, the feed situated at a distance from the antenna corresponding to a focal distance of the antenna along a propagation vector of the planar wave-front,
wherein the spatial field of view of the antenna system is based on a number
15 of the plurality of feeds and the spacing between feeds of the plurality of feeds,
the antenna thereby producing, for each feed of the plurality of feeds, a respective high-gain beam, wherein the direction of the respective high-gain beam is along the line connecting the center of the spherical symmetry and the each feed.
2. The antenna system of claim 1, wherein the antenna is one of a lens antenna
20 and a shaped reflector.
3. The antenna system of claim 2, wherein the lens antenna is spherical.
4. The antenna system of claim 3, wherein the lens antenna is a spherical constant-K dielectric antenna.
5. The antenna system of claim 3, wherein the lens antenna is a Luneburg lens
25 antenna.
6. The antenna system of claim 2, wherein the lens antenna is a hemispherical antenna.

7. The antenna system of any of claims 2 to 6, wherein the shaped reflector is a circular reflector.
8. The antenna system of any of claims 2 to 7, wherein the feed manifold is a sectoral feed manifold.
- 5 9. The antenna system of claim 8, wherein the spacing between the feeds is equal to or less than half of a wavelength of the at least one electro-magnetic signal.
10. The antenna system of any of claims 8 to 9, wherein the distance from the antenna differs from the focal distance, thereby decreasing a focus of the feed, thereby widening a received beam width of the respective high-gain beam, thereby reducing a sensitivity of the cross-over loss of the respective high-gain beam to the spacing between feeds.
- 10 11. The antenna system of any of claims 8 to 10, wherein the each feed comprises an RF choke, thereby enabling reduction of electro-magnetic coupling between adjacent feeds.
- 15 12. The antenna system of any of claims 1 to 11, wherein the feed manifold is a multi-dimensional feed manifold.
13. The antenna system of any of claims 1 to 12, wherein the feed manifold is configured for mechanical rotation, thereby enabling change of a center of the spatial field of view.
- 20 14. The antenna system of any of claims 1 to 13, wherein the spatial field of view comprises a 90 degree field of view.
15. The antenna system of any of claims 1 to 13, wherein the spatial field of view comprises a 120 degree field of view.
16. The antenna system of any of claims 1 to 15, wherein the each feed comprises a waveguide horn.
- 25 17. The antenna system of claim 16, wherein the waveguide horn is a horizontally-polarized waveguide horn.

18. The antenna system of any of claims 1 to 17, wherein the system comprises a sectoral polarizer.
19. The antenna system of any of claims 1 to 18, wherein the system comprises a sectoral radome.
- 5 20. The antenna system of any of claims 1 to 19, wherein the system comprises a front-end circuit.
21. The antenna system of any of claims 1 to 20, wherein the feed manifold comprises two opposite halves.
22. The antenna system of any of claims 1 to 21, wherein the antenna system
10 further comprises a first processing circuitry, the first processing circuitry configured to perform weighted summing of adjacent respective high-gain beams, thereby enabling production of intermediate virtual high gain beams.
23. The antenna system of any of claims 1 to 22, wherein the antenna system
15 comprises a second processing circuitry, the second processing circuitry configured to perform direction finding of the at least one electro-magnetic signal by amplitude comparison of adjacent high-gain beams.
24. A system for processing of electro-magnetic signals, comprising a third
processing circuitry, the third processing circuitry configured to perform a
computerized method, the computerized method comprising the following:
- 20 i. receive at least one sampled received signal, comprising at least one emitted signal emitted by a transmitter;
- ii. determine at least one point in a parameter space, wherein the at least
one point in the parameter space comprises: at least one value of pulse
width, at least one value of Pulse Repetition Interval (PRI), at least one
25 value of initial time, and at least one value of number of pulses
integrated, wherein the number of integrated pulses is at least two;
- iii. perform an integration associated with the sampled received signal,

- based on the at least one at least one point in the parameter space,
thereby deriving at least one integrated power correlating the at least
one sampled received signal with the at least one point;
- iv. determine a derived integrated power of the at least one integrated
5 power which meets a signal-to-noise (SNR) condition, the derived
integrated power constituting a chosen integrated power;
- v. determine a point of the at least one point in the parameter space that
correlates with the chosen integrated power; and
- vi. determine that parameters corresponding to the determined point
10 constitute parameters of the at least one emitted signal,
thereby detecting the at least one emitted signal.
25. The system of claim 24, wherein said step (c) is performed for first increasing
values of number of pulses, until the derived integrated power meets a first
SNR threshold condition.
- 15 26. The system of claim 25, the method further comprising performing said step (c)
for second increasing higher values of the number pulses, for a first modified
parameter space comprising a subset of at the least one value of pulse width,
the at least one value of PRI, and the at least one value of initial time, wherein
the first modified parameter space is based on the performance of said step
20 (c) for the first increasing higher values, wherein the second increasing higher
values are larger than the first increasing higher values.
27. The system of any one of claims 24 to 26, wherein the SNR condition comprises
a SNR of the chosen integrated power being above a required SNR.
28. The system of any one of claims 24 to 27, the chosen integrated power being a
25 maximum derived integrated power, corresponding to a maximum SNR.
29. The system of any one of claims 24 to 28, wherein the integration comprises
summation of energy of the at least one the sampled received signal.

30. The system of any one of claims 24 to 29, wherein the least one emitted signal comprises a modulated signal.
31. The system of any one of claims 24 to 30, wherein the least one emitted signal comprises a non-coherent signal.
- 5 32. The system of any one of claims 24 to 31, wherein the least one emitted signal comprises a coherent signal, wherein the integration comprises signal voltage integration of the sampled received signal, thereby enabling an improvement in SNR of the detected emitted, as compared to a non-coherent integration.
- 10 33. The system of claim 32, wherein the improved SNR is proportional to the number of integrated pulses.
34. The system of any one of claims 24 to 33, wherein said step (c) is performed utilizing a non-coherent integration, until the derived integrated power meets a second SNR threshold condition, the method further comprising performing
- 15 said step (c) for a second modified parameter space comprising a subset of at the least one value of pulse width, the at least one value of PRI, and the at least one value of initial time, wherein the second modified parameter space is based on the non-coherent integration.
35. An antenna system, configured to detect weak electro-magnetic signals,
- 20 comprising:
- a. an antenna;
 - b. a feed manifold, the feed manifold comprising a plurality of feeds located on a focal surface of the antenna; and
 - c. a third processing circuitry, the third processing circuitry configured to
- 25 perform a computerized method,
- wherein the antenna is configured to function as a two-dimensional focusing element, having spherical symmetry,

wherein the antenna system is configured such that a planar wave-front impinging on the antenna, the planar wave-front associated with the least one electromagnetic signal, is focused by the antenna to a feed of the plurality of feeds, the feed situated at a distance from the antenna corresponding to a focal distance of the antenna along a propagation vector of the planar wave-front,

wherein the spatial field of view of the antenna system is based on a number of the plurality of feeds and the spacing between feeds of the plurality of feeds,

the antenna thereby producing a plurality of high-gain beams, each respective high-gain beam of the plurality of high-gain beams associated with each feed of the plurality of feeds, wherein the direction of the each respective high-gain beam is along the line connecting the center of the spherical symmetry and the each feed, wherein a plurality of the respective high-gain beams constituting at least one sampled received signal,

wherein the computerized method comprises the following:

- i. receive at least one sampled received signal, comprising at least one emitted signal emitted by a transmitter;
- ii. determine at least one point in a parameter space, wherein the at least one point in the parameter space comprises: at least one value of pulse width, at least one value of Pulse Repetition Interval (PRI), at least one value of initial time, and at least one value of number of pulses integrated, wherein the number of integrated pulses is at least two;
- iii. perform an integration associated with the sampled received signal, based on the at least one point in the parameter space, thereby deriving at least one integrated power correlating the at least one sampled received signal with the at least one point;
- iv. determine a derived integrated power of the at least one integrated power

which meets a signal-to-noise (SNR) condition, the derived integrated power constituting a chosen integrated power;

v. determine a point of the at least one point in the parameter space that correlates with the chosen integrated power; and

5 vi. determine that parameters corresponding to the determined point constitute parameters of the at least one emitted signal, thereby detecting the at least one emitted signal.