CLAIMS:

1. An antenna system, configured to detect weak electro-magnetic signals, comprising:
   a. an antenna; and
   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 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 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 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 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.

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,

wherein the plurality of feeds are arranged, such that phase centers of adjacent respective high-gain beams, having the widened received beam width, are close enough to produce a beam overlap, between the adjacent respective high-gain beams, having a crossover loss equal to or less than 3 dB.

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.

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.

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.

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.

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 plurality of feeds are arranged, such that the phase centers of the adjacent respective high-gain beams are close enough to produce beam overlap, between the adjacent respective high-gain beams, having a crossover loss equal to or less than 3 dB, wherein the antenna system further comprises a first processing circuitry, the first processing circuitry configured to perform weighted summing of the 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 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. An antenna system, configured to detect weak electro-magnetic signals, 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 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 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 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

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.