CLAIMS

1. A method of determining a direction of arrival of a radio signal being emitted by a radio emitter, the method comprising:

moving a single antenna through multiple spatial positions;

generating a motion data indicative of the movement of the single antenna;

receiving, by the single antenna, the radio signal at two or more of the multiple spatial positions;

determining two or more residual phase values, each based on the radio signal received by the single antenna at one of the two or more spatial positions and based on a radio signal frequency;

determining at least one residual phase difference value between at least two of the two or more determined residual phase values; and

determining, based on the at least one residual phase difference value and at least a portion of the motion data, one or more directions of arrival of the radio signal.

2. The method of claim 1, comprising determining a geolocation of the radio emitter based on one of:

at least one of the one or more determined directions of arrival of the radio signal and a geolocation of at least one of the two or more spatial positions; and

three or more determined directions of arrival of the radio signal.

3. The method of ~~any one of~~ claim~~s~~ 1~~-2~~, comprising generating the motion data using a motion sensing unit connected to the single antenna, the motion sensing unit comprises at least one of: one or more inertial sensors, one or more accelerometers, one or more gyros, one or more compasses, one or more geolocation sensors and one or more optical sensors.

4. The method of claim 3, comprising detecting that the single antenna is stationary based on two or more image frames obtained by the one or more optical sensors of the motion sensing unit; and further comprising at least one of:

determining the radio signal frequency based on the radio signal received by the stationary single antenna; and

calibrating at least one component of the motion sensing unit when the single antenna and the motion sensing unit connected thereto are stationary.

5. The method of ~~any one of~~ claim~~s~~ 1~~-4~~, wherein the radio signal is a modulated radio signal and the method comprising:

converting the modulated radio signal received by the single antenna to a demodulated coherent signal; and

determining the two or more residual phase based on the demodulated coherent signal.

6. The method of claim 5, wherein the converting comprising:

generating a synthetic signal having the radio signal frequency;

determining an added phase value based on the modulated radio signal and the synthetic signal; and

determining the coherent demodulated signal based on the modulated radio signal, the synthetic signal and the added phase value.

7. The method of ~~any one of~~ claim~~s~~ 1~~-5~~, wherein the radio signal is a modulated radio signal and the method comprising passing the modulated radio signal received by the single antenna through a finite impulse response (FIR) filter to determine a residual phase value of the received modulated radio signal.

8. The method of claim 7, comprising determining coefficients of the FIR filter based on samples recovered from known repetitive data and waveform parameters of the received modulated radio signal.

9. The method of ~~any one of~~ claim~~s~~ 1~~-8~~, comprising:

selecting one or more pairs of spatial positions of the two or more spatial positions at which the single antenna has received the radio signal, each of the one or more pairs has a first spatial position and a second spatial position;

for each of the one or more pairs:

determining, based on the motion data, a distance between the first spatial position and the second spatial position of the respective pair;

determining a first residual phase value based on the radio signal frequency and based on the radio signal received by the single antenna at the first spatial position of the respective pair;

determining a second residual phase value based the radio signal frequency and based on the radio signal received by the single antenna at the second spatial position of the respective pair; and

determining the direction of arrival of the radio signal based on the determined distance between the first spatial position and the second spatial position, the first residual phase value and the second residual phase value.

10. The method of claim 9, comprising selecting the one or more pairs such that the first spatial position and the second spatial position of each of the one or more pairs are subsequent spatial positions of the multiple spatial position through which the single antenna has been moved.

11. The method of ~~any one of~~ claim~~s~~ 9~~-10~~, comprising determining one or more sets of possible directions of arrival of the radio signal, each of the one or more sets is for a pair of the one or more selected pairs of spatial positions for which the distance between the first spatial position and the second spatial position of the respective pair is greater than half of a wavelength of the radio signal.

12. The method of claim 11, comprising determining a most probable direction of arrival of the radio signal based on the sets of possible directions of arrival thereof and based on one of:

a largest number of occurrences of each of the possible directions of arrival in the one or more sets; and

a number of occurrences of each of the possible directions of arrival in the one or more sets that exceeds a predetermined threshold.

13. The method of ~~any one of~~ claim~~s~~ 1~~-12~~, comprising:

moving a first antenna through a first set of multiple spatial positions and receiving, by the first antenna, the radio signal at two or more of the multiple spatial positions of the first set;

moving a second antenna through a second set of multiple spatial positions and receiving, by the second antenna, the radio signal at two or more of the multiple spatial positions of the second set;

determining the one or more directions of arrival of the radio signal based on the radio signal being received by the first antenna and the second antenna.

14. A system for determining a direction of arrival of a radio signal being emitted by a radio emitter, the system comprising:

a single antenna configured to be moved through multiple spatial positions and configured to receive the radio signal at two or more of the multiple spatial positions; and

a controller configured to determine one or more directions of arrival of the radio signal based on:

a radio signal frequency;

at least one residual phase difference value between at least two of two or more residual phase values each obtained based on the radio signal received by the single antenna at one of the two or more multiple spatial positions; and

at least a portion of a motion data indicative of the movement of the single antenna.

15. The system of claim 14, wherein the controller is configured to determine the two or more residual phase values.

16. The system of claim 14, comprising a homodyne receiver down converter configured to determine the two or more residual phase values and to provide the two or more residual phase values to the controller.

17. The system of ~~any one of~~ claim~~s~~ 14~~-16~~, wherein the controller is configured to determine a geolocation of the radio emitter based on one of:

at least one of the one or more determined directions of arrival of the radio signal and a geolocation of at least one of the two or more spatial positions; and

three or more determined directions of arrival of the radio signal.

18. The system of ~~any one of~~ claim~~s~~ 14~~-17~~, comprising a motion sensing unit connected to the single antenna, the motion sensing unit comprises at least one of: one or more inertial sensors, one or more accelerometers, one or more gyros, one or more compasses, one or more geolocation sensors and one or more optical sensors.

19. The system of claim 18, wherein the controller is configured to detect that the single antenna is stationary based on two or more image frames obtained by the one or more optical sensors of the motion sensing unit; and is further configured to at least one of:

determine the radio signal frequency based on the radio signal received by the stationary single antenna; and

calibrate at least one component of the motion sensing unit when the single antenna and the motion sensing unit connected thereto are stationary.

20. The system of ~~any one of~~ claim~~s~~ 14~~-19~~, wherein the radio signal is a modulated radio signal and the controller is configured to:

convert the modulated radio signal received by the single antenna to a demodulated coherent signal; and

determine the two or more residual phase values and the direction of arrival of the radio signal based on the demodulated coherent signal.

~~21. The system of claim 20, wherein the controller is configured to convert the modulated radio signal received by the single antenna to the demodulated coherent signal by:~~

~~generating a synthetic signal having the radio signal frequency;~~

~~determining an added phase value based on the modulated radio signal and the synthetic signal; and~~

~~determining the coherent demodulated signal based on the modulated radio signal, the synthetic signal and the added phase value.~~

~~22. The system of any one of claims 14-19, wherein the radio signal is a modulated radio signal and the controller is configured to pass the modulated radio signal received by the single antenna through a finite impulse response (FIR) filter to determine a residual phase value of the received modulated radio signal.~~

~~23. The system of claim 22, wherein the controller is configured to determine coefficients of the FIR filter based on samples recovered from known repetitive data and waveform parameters of the received modulated radio signal.~~

~~24. The system of any one of claims 14-23, wherein the controller is configured to:~~

~~select one or more pairs of spatial positions of the two or more spatial positions at which the single antenna has received the radio signal, each of the one or more pairs has a first spatial position and a second spatial position;~~

~~for each of the one or more pairs:~~

~~determine, based on the motion data, a distance between the first spatial position and the second spatial position of the respective pair;~~

~~obtain a first residual phase value based on the radio signal frequency and the radio signal received by the single antenna at the first spatial position of the respective pair;~~

~~obtain a second residual phase value based the radio signal frequency and the radio signal received by the single antenna at the second spatial position of the respective pair; and~~

~~determine the direction of arrival of the radio signal based on the determined distance between the first spatial position and the second spatial position, the first residual phase value and the second residual phase value.~~

~~25. The system of claim 24, wherein the controller is configured to select the one or more pairs such that the first spatial position and the second spatial position of each of the one or more pairs are subsequent spatial positions of the multiple spatial position through which the single antenna has been moved.~~

~~26. The system of any one of claims 24-25, wherein the controller is configured to determine one or more sets of possible directions of arrival of the radio signal, each of the one or more sets is for a pair of the one or more selected pairs of spatial positions for which the distance between the first spatial position and the second spatial position of the respective pair is greater than half of a wavelength of the radio signal.~~

~~27. The system of claim 26, wherein the controller is configured to determine a most probable direction of arrival of the radio signal based on the sets of possible directions of arrival thereof and based on one of:~~

~~a largest number of occurrences of each of the possible directions of arrival in the one or more sets; and~~

a number of occurrences of each of the possible directions of arrival in the one or more sets that exceeds a predetermined threshold.

28. The system of any one of claims 14-27, comprising:

a first antenna configured to be moved through a first set of multiple spatial positions and configured to receive, by the first antenna, the radio signal at two or more of the multiple spatial positions of the first set;

a second antenna configured to be moved through a second set of multiple spatial positions and configured to receive, by the second antenna, the radio signal at two or more of the multiple spatial positions of the second set; and

wherein the controller is configured to determine the one or more directions of arrival of the radio signal based on the radio signal being received by the first antenna and the second antenna.