CLAIMS

1. A method for determining properties of an electromagnetic waveform, the method comprising:

providing measured parametric EM field data indicative of measured vector components of electric and magnetic fields of an EM waveform measured in at least one instance of time;

providing reference data indicative of a plurality of reference data sets, each data set comprising: a reference steering vector parameters indicative of a certain respective direction of arrival (DOA), and a corresponding parametric EM field reference data including reference vector components of an electric and magnetic field pertaining to a wavefront propagating with the DOA of the corresponding reference steering vector parameters;

determining a matching score between the measured parametric EM field data and the parametric EM field reference data of one or more of the reference data sets; and

in case the matching score of a certain reference data set complies with a certain threshold condition, determining that said measured parametric EM field data corresponds to said EM waveform having a single EM wavefront thereby enabling to discriminate between measured EM waveforms having a single wavefront and measured EM waveforms having multiple wavefronts.

2. The method of claim 1, comprising, upon determining that said EM waveform has a single EM wavefront, estimating a DOA of said single EM wavefront based on the reference steering vector parameters of said certain reference data set whose matching score complies with said certain threshold condition.

3. The method of claim 1 or 2 comprising determining a plurality of matching scores between the measured parametric EM field data and the parametric EM field reference data of each reference data set of said plurality of reference data sets respectively; and at least one of the following:

a. in case none of said plurality of matching scores complies with said certain threshold condition, determining that said measured parametric EM field data corresponds to the EM field measured under interference conditions, by which DOA cannot be accurately estimated;

b. at least in case one or more ~~than one~~ matching scores associated with a certain respective one or more candidate reference data sets comply with said certain threshold condition, applying further processing to said certain respective candidate reference data set, based on predetermined data on properties of a source of said electromagnetic waveform, to thereby filter out from said one or more candidate reference data sets, candidate reference data sets whose respective reference steering vector~~s~~' parameters do not comply with said predetermined data.

4. The method of Claim 3~~.b~~ wherein the measured parametric EM field is obtained by at least one parametric EM field sensing device (vector sensor); and

wherein said predetermined data pertains to a state of polarization of said source, thereby enabling to discriminate between single path waveforms and multipath waveforms which are associated with reflection/scattering from objects in relative vicinity to said source, as compared to their distance from the vector sensor.

5. The method of any one of Claims 1 to 4 wherein the measured parametric EM field data is indicative of nominal vector components of said electric and magnetic fields obtained from a plurality of measurements of said electric and magnetic fields taken in a plurality of time instances.

6. The method of Claim 5 wherein said nominal vector components of said electric and magnetic fields are obtained by processing said plurality of measurements of said electric and magnetic fields which are taken in a plurality of time instances; and wherein preferably at least one of the following:

- said processing comprises averaging of said plurality of measurements;
- said processing comprises coherent integration of said plurality of measurements;
- said measured vector components are obtained from a sensor being under movement conditions.

7. The method of Claim 5 or 6 wherein said measured parametric EM field data pertains to a certain frequency and wherein the method comprises processing said plurality of measurements of said electric and magnetic fields taken in the plurality of time instances, to determine frequency contents of the measured electric and magnetic

fields in at least said certain frequency such that said nominal vector components pertain to amplitudes of components of said electric and magnetic fields associated with said certain frequency.

8. The method of any one of Claims 1 to 7 wherein the matching score between the measured parametric EM field data and the parametric EM field reference data of a certain reference data set is determined by computing an inner product between the measured parametric EM field data and the parametric EM field reference data of the certain reference data set; and wherein preferably said inner product is computed by at least one of the following:

- said inner product is computed between normalized values of the measured parametric EM field data and the parametric EM field reference data of the certain reference data set; and
- said inner product is computed as a generalized (coherent) inner product computed based on a covariance of said measured parametric EM field data and said the parametric EM field reference data of the certain reference data set.

9. The method of Claim 5 or 6 wherein said nominal vector components of the electric and magnetic fields pertain to electric and magnetic fields of a certain temporal form; and wherein said plurality of reference data sets are associated with one or more predetermined temporal forms; and preferably at least one of the following:

- said certain temporal form and said one or more predetermined temporal forms are pulse forms of predetermined widths;
- the matching score between the measured parametric EM field data and the parametric EM field reference data of a certain reference data set is determined by computing a correlation between normalized values of the measured parametric EM field data and the parametric EM field reference data of the certain reference data set.

10. The method of any one of Claims 1 to 9 wherein the reference steering vector parameters of at least one reference data set of said reference data, is indicative of at least one of the following:

- a two dimensional direction of arrival (DOA) of the corresponding parametric EM field reference data characterized by (Θ,φ); and wherein determining compliance of the matching score with said certain threshold condition thereby provides

an un-ambiguous estimate of two dimensional direction of arrival (DOA) of a wavefront associated with said measured parametric EM field;

- polarization parameters of the corresponding parametric EM field reference data; and wherein determining compliance of the matching score with said certain threshold condition thereby provides an un-ambiguous estimate of the direction of arrival (DOA) of a wavefront associated with said measured parametric EM field and polarized with said polarization parameters.

11. The method of any one of Claims 1 to 10 wherein the measured parametric EM field is obtained by at least one parametric EM field sensing device (vector sensor) comprising three or more sensing modules (antenna elements) arranged to span sensing of at least one of an electric field or a magnetic field in 3D coordinates.

12. The method of ~~any one of~~ Claim~~s~~ ~~4~~1 or~~to~~ 11 wherein said reference data is adjusted to a certain location at which the at least one vector sensor is located so as to compensate over warping effect of objects in the vicinity of said location on the measured parametric EM field sensed at said location.

13. A system for determining properties of an electromagnetic waveform, the system comprising:

a measurements' preprocessor module connectable to a vector sensor and adapted to provide measured parametric EM field data indicative of measured vector components of electric and magnetic fields of an EM waveform measured in at least one instance of time;

a reference data provider module connectable to a reference data repository comprising reference data and adapted to provide a plurality of reference data sets, each data set comprising: a reference steering vector parameters indicative of a certain respective direction of arrival (DOA), and a corresponding parametric EM field reference data including reference vector components of an electric and magnetic field pertaining to a wavefront propagating with the DOA of the corresponding reference steering vector parameters;

a comparison module configured and operable for determining matching scores between the measured parametric EM field data and the parametric EM field reference data of one or more of the reference data sets; and

an interference estimator module configured to determine whether said EM waveform having a single EM wavefront based on compliance of at least one of said matching scores with a certain threshold condition, thereby enabling to discriminate between measured EM waveforms having a single wavefront and measured EM waveforms having multiple wavefronts.

14. The system claim 13, wherein the comparison module is adapted to determine as candidate reference data sets, one or more of the reference data sets whose respective matching scores comply with said certain threshold condition; and wherein at least one of the following:

- said interference estimator module further comprises a filtration module configured and operable to filter out, form said one or more candidate reference data sets, certain candidate reference data sets whose respective reference steering vectors' parameters do not comply with ~~said~~ predetermined data indicative of properties of a source of said EM waveform, whereby preferably said predetermined data pertains to an a-priory data indicative of a state of polarization of said source;
- the system comprises a DOA/ state of polarization (SOP) estimator module configured and operable for estimating a DOA of said ~~EM~~ wavefront based on the reference steering vector parameters of said certain reference data set whose matching score complies with said certain threshold condition;
- said interference estimator module is adapted to determine that in case none of said matching scores complies with said certain threshold condition, said measured parametric EM field data corresponds to the EM field measured under interference conditions, by which DOA cannot be accurately estimated.

15. The system of Claim 13 or 14 wherein the measurements preprocessor module is adapted to obtain a plurality of measurements of said electric and magnetic fields taken in a plurality of time instances and for processing said plurality of measurements to obtain said measured parametric EM field data as indicative of nominal vector components of said electric and magnetic fields.

16. The system of Claim 15wherein said nominal vector components of the electric and magnetic fields pertain to electric and magnetic fields of a certain frequency; and wherein said plurality of reference data sets are frequency specific

reference data sets whose parametric EM field reference data pertain to said certain frequency.

17. The system of any one of Claims 13 to 16 wherein said comparison module is configured and operable for determining said matching scores between the measured parametric EM field data and the parametric EM field reference data sets ~~of the~~ by respectively computing inner products between the measured parametric EM field data and the corresponding parametric EM field reference data of the respective reference data sets; and wherein at least one of the following:

- said inner products are computed between normalized values of the measured parametric EM field data and the corresponding parametric EM field reference data of the respective reference data sets; and
- said inner products are computed as generalized (coherent) inner products computed based on covariance of said measured parametric EM field data and the corresponding parametric EM field reference data of the respective reference data sets.

18. The system of any one of Claims 1~~3~~5 to 1~~6~~7 wherein said nominal vector components of the electric and magnetic fields pertain to electric and magnetic fields of a certain temporal form; and wherein said plurality of reference data sets are associated with one or more predetermined temporal forms; and

wherein preferably said comparison module is configured and operable for determining the respective matching scores between the measured parametric EM field data and the parametric EM field reference data of respective reference data sets by computing correlations between normalized values of the measured parametric EM field data and the corresponding parametric EM field reference data of the respective reference data sets.

19. The system of any one of Claims 13 to 18 wherein the reference steering vector parameters of at least one reference data set of said reference data, is indicative of one or more of the following:

- direction of arrival (DOA) of the corresponding parametric EM field reference data characterized by (Θ,φ);

- polarization parameters of the corresponding parametric EM field reference data.

20. The system of any one of Claims 13 to 19 comprising or being connected to a parametric EM field sensing device (vector sensor) and wherein at least one of the following:

- said reference data is specific to a type of said parametric EM field sensing device, and includes compensation over warping/distortion effect of said EM field sensing device on the measured parametric EM field sensed by the EM field sensing device;

- said parametric EM field sensing device being a single parametric EM field sensing device located at a certain location or platform and wherein said reference data is adjusted according to said certain location or platform so as to compensate over warping effect of objects in the vicinity of said certain location or platform location.