Claims

1. A method for determining target parameters by directionally selective reception of sound waves, which are emitted or transmitted by a target, with an arrangement (20) of waterborne acoustic sensors of a sonar receiver system, from estimated bearing angles (B_{est}), which are determined from estimated positions of the target, and bearing angles (B_{meas}) measured by the arrangement (20), wherein a bearing angle difference is determined between the measured bearing angles (B_{meas}) and the estimated bearing angles (B_{est}),
characterized in that
at least one support value (29) is determined from a set of possible support values (27),
one or a plurality of target tracks (Z(i, j)) are determined with respective associated target parameters and a respective associated evaluation quantity (Q(i, j)), wherein the evaluation quantity (Q(i, j)) is determined from the bearing angle difference associated with the respective target track and the support value (29) or the support values (29),
a best target track (Z_{best}) is determined with associated target parameters using the associated evaluation quantity, wherein the associated target parameters are output as the target parameters to be determined,
a plurality of different target tracks (Z(i, j)) are determined, wherein a first locating beam (2) associated with a first measured bearing angle and a last locating beam (4) associated with a last measured bearing angle are determined and each assumed target track starts on the first locating beam (2) at a starting point (6) and ends on the last locating beam (4) at an end point (8), the evaluation quantity (Q(i, j)) is determined taking

into account at least one support value (29) for each target track and a best target track (Z_{best}) giving the best solution is determined using said evaluation quantities (Q(i, j)) and its associated target parameters are output as the best solution, and

during each processing cycle the target parameters of all or a plurality of the target tracks (Z(i, j)) are graphically displayed against the target course and/or against the target speed and/or against the target range on a display device (38) by means of one or more diagrams of a quality measure (Q*(i, j)) arising from the evaluation quantity (Q(i, j)).

2. The method ~~as claimed in~~according to claim 1, characterized in that

data relating to possible support values (27) are collected that specify which support values are available from a quantity of all support values, data relating to the reliability of the possible support values (27) are collected, the data regarding the possible support values (27) are transferred with the data relating to their reliability to a decision module (28), which determines therefrom the support value(s) (29) with respective associated weighting factors that are taken into account during implementation of the method.

3. The method ~~as claimed in~~according to claim 1 or 2, characterized in that

the evaluation quantity (Q(i, j)) of a target track (Z(i, j)) is calculated from the sum of the, especially weighted, squares of differences of the estimated bearing angles (B_{est}) and the associated measured bearing angles (B_{meas}) along the target

track (Z(i, j)) while taking into account at least one, especially weighted, support value (29).

4. The method ~~as claimed in~~according to any one of the preceding claims,
characterized in that
reception signals (21) of the arrangement are subjected to a frequency analysis, especially a Lofar analysis or a Demon analysis, and the frequency of at least one spectral line is determined as the reception frequency (F_{meas}) for each bearing angle,
a frequency difference of the reception frequency (F_{meas}) and an estimated Doppler frequency (F_{est}) is determined for each bearing angle, wherein the estimated Doppler frequency (F_{est}) is determined from an estimated transmission frequency (F_{Sest}) emitted by the target and a Doppler shift and
the evaluation quantity (Q(i, j)) is determined from the bearing angle difference, the frequency differences and at least one support value (29), especially a frequency support value (F_{sup}), for one or a plurality of target tracks (Z(i, j)).

5. The method ~~as claimed in~~according to any one of the preceding claims,
characterized in that
during each processing cycle of a series of successive processing cycles the evaluation quantity (Q(i, j)) or a variable derived from the evaluation quantity is iteratively minimized while taking into account at least one support value (29), and on reaching the minimum the target track (Z_{best}) associated with the minimum evaluation quantity provides the target parameters of the best solution.

~~6. The method as claimed in any one of the claims 1 through 4,~~
~~characterized in that~~
~~a plurality of different target tracks (Z(i, j)) are determined, wherein a first locating beam (2) associated with a first measured bearing angle and a last locating beam (4) associated with a last measured bearing angle are determined and each assumed target track starts on the first locating beam (2) at a starting point (6) and ends on the last locating beam (4) at an end point (8), the evaluation quantity (Q(i, j)) is determined taking into account at least one support value (29) for each target track and a best target track (Z_{best}) giving the best solution is determined using said evaluation quantities (Q(i, j)) and its associated target parameters are output as the best solution.~~

~~7.~~6. The method ~~as claimed in~~according to claim ~~6~~1,
characterized in that
for determining the target parameters only those target tracks (Z(i, j)) are taken into account whose associated evaluation quantity (Q(i, j)) has fallen below at least one predetermined threshold value.

~~8. The method as claimed in one of the claims 6 through 7,~~
~~characterized in that~~
~~during each processing cycle the target parameters of all or a plurality of the target tracks (Z(i, j)) are graphically displayed against the target course and/or against the target speed and/or against the target range on a display device (38) by means of one or more diagrams of a quality measure (Q*(i, j)) arising from the evaluation quantity (Q(i, j)).~~

~~9.~~ 7. The method ~~as claimed in one of the~~according to any of claims 1 to 6~~ through 7~~, characterized in that during each processing cycle future target positions of the target are determined for all or a plurality of the target tracks (Z(i, j)) and a solution space containing the possible target parameters, which comprises a future expected area (48) representing the future target positions, at least one range solution space (46) for indicating the possible solutions for the target range and/or the best target track (Z_{best}), is displayed graphically and/or numerically on a display device (38).

~~10.~~ 8. A device for determining target parameters by directionally selective reception of sound waves, which are emitted or transmitted by a target, with an arrangement (20) of waterborne acoustic sensors of a sonar receiver system, wherein the device is designed so as to determine estimated bearing angles (B_{est}) from estimated positions of the target and bearing angles (B_{meas}) measured by means of the arrangement (20), and wherein a bearing angle difference between measured bearing angles (B_{meas}) and estimated bearing angles (B_{est}) can be determined,
characterized by
a decision module (28) that is designed so as to determine at least one support value (29) from a set of possible support values (27), a target track determination unit (30) that is designed to determine one or a plurality of target tracks (Z(i, j)) with respective associated target parameters and a respective associated evaluation quantity (Q(i, j)), wherein the evaluation quantity (Q(i, j)) can be determined from the bearing angle

difference associated with each target track and the support value (29) or the support values (29),
an evaluation unit (32) that is designed so as to determine a best target track (Z_{best}) with associated target parameters using the associated evaluation quantity, wherein the associated target parameters can be specified as the target parameters to be determined,
a design of the target track determination unit (30) such that a plurality of different target tracks (Z(i, j)) can be determined, wherein a first locating beam (2) associated with a first measured bearing angle and a last locating beam (4) associated with a last measured bearing angle can be specified and each assumed target track can be displayed such that it starts on the first locating beam (2) at a starting point (6) and ends on the last locating beam (4) at an end point (8),
and that the evaluation quantity (Q(i, j)) can be determined while taking into account at least one support value (29) for each target track and a best target track (Z_{best}) giving the best solution can be determined using said evaluation quantity (Q(i, j)), wherein its associated target parameters can be displayed as the best solution, and
a display unit (34) that is designed so as to graphically display on a display device (38), during each processing cycle, the target parameters of all or a plurality of the target tracks (Z(i, j)) using a plurality of diagrams of a quality measure (Q*(i, j)) arising from the evaluation quantity (Q(i, j)) against the target course and/or against the target speed and/or the target range, and/or
to determine future target positions of the target for all or a plurality of target tracks (Z(i, j)) and to graphically and/or numerically display on a display device (38) a solution space containing the

possible target parameters, which comprises an expected area (48) representing the future target positions, at least one range solution space (46) for indicating the possible solutions for the target range and/or the best target track (Z_{best}).

9. The device ~~as claimed in~~according to claim ~~10~~8, characterized by
a data acquisition module that is designed so as to record data of possible support values (27), wherein the data comprise indications as to which support values are available from a quantity of all support values,
a data acquisition of reliabilities of the possible support values (27),
another design of the decision module (28) so as to evaluate the data relating to the possible support values (27) with the data relating to their reliability so as to determine the support value(s) (29) with (a) respective associated weighting factor(s).

10. The device ~~as claimed in~~according to any of claims ~~10~~8 ~~through~~ to ~~11~~9, characterized by
a frequency analysis circuit (36) that is designed to subject the reception signals (21) of the arrangement to a frequency analysis, especially a Lofar analysis or a Demon analysis, wherein the frequency of at least one spectral line can be determined as the reception frequency (F_{meas}) for at least one bearing angle,
a design of the target track determination unit (30) such that a frequency difference of the reception frequency (F_{meas}) and an estimated Doppler frequency (F_{est}) for each bearing angle can be determined, wherein the estimated Doppler frequency (F_{est}) can be determined from an estimated

transmission frequency (F_{Sest}) emitted by the target and a Doppler shift,
as well as by the evaluation quantity (Q(i, j)) being able to be determined for one or a plurality of target tracks (Z(i, j)) from the bearing angle difference, the frequency differences and at least one support value (29), especially a frequency support value (F_{sup}).

11. The device ~~as claimed in~~according to any of claims ~~10~~ 8 ~~through~~ to ~~12~~10,
characterized by
a design of the target track determination unit (30) such that during each processing cycle of a series of successive processing cycles the evaluation quantity (Q(i, j)), or a variable derived from the evaluation quantity, can be iteratively minimized taking into account at least one support value (29) and on reaching the minimum the target parameters of the best solution, which is associated with the minimum evaluation quantity, can be delivered.

~~14. The device as claimed in claims 10 through 12,~~
~~characterized by~~
~~a design of the target track determination unit (30) such that a plurality of different target tracks (Z(i, j)) can be determined, wherein a first locating beam (2) associated with a first measured bearing angle and a last locating beam (4) associated with a last measured bearing angle can be specified and each assumed target track can be displayed such that it starts on the first locating beam (2) at a starting point (6) and ends on the last locating beam (4) at an end point (8),~~
~~and that the evaluation quantity (Q(i, j)) can be determined while taking into account at least one support value (29) for each target track and a best~~

~~target track (Z_{best}) giving the best solution can be determined using said evaluation quantity (Q(i, j)), wherein its associated target parameters can be displayed as the best solution.~~

~~15. The device as claimed in claim 14 characterized by~~

~~a display unit (34) that is designed so as to graphically display on a display device (38), during each processing cycle, the target parameters of all or a plurality of the target tracks (Z(i, j)) using a plurality of diagrams of a quality measure (Q*(i, j)) arising from the evaluation quantity (Q(i, j)) against the target course and/or against the target speed and/or the target range, and/or~~

~~to determine future target positions of the target for all or a plurality of target tracks (Z(i, j)) and to graphically and/or numerically display on a display device (38) a solution space containing the possible target parameters, which comprises an expected area (48) representing the future target positions, at least one range solution space (46) for indicating the possible solutions for the target range and/or the best target track (Z_{best}).~~