

CLAIMS

1. Method of locating communicating objects forming a fleet, comprising the steps of:
 - defining an absolute reference system in which coordinates of positions of the communicating objects are defined;
 - defining at least three positions by their coordinates in the absolute reference system;
 - associating said at least three positions with three communicating objects, referred to as three reference objects;
 - detecting, through at least one of the reference objects, other two reference objects;
 - measuring, through said at least one of the reference objects, a distance of said at least one of the reference objects from said other two other reference objects;
 - measuring a distance of at least two reference objects from a fourth communicating object, a geometric locus of distant points of a reference object from the fourth communication object is an orbit of the reference object;
 - locating, through said at least one reference object, the fourth communicating object from at least two previously-established orbits and at least one distance among the distances between the three reference objects; and
 - wherein a length of the fleet is greater than a detection range of the communicating objects, a given communicating object exchanges identity data and location data with communicating objects in an immediate environment of said given communicating object, each communicating object in the immediate environment of said given communicating object relays said identity and location data to all communicating objects in an immediate environment of said each communicating object until each communicating object of the fleet has knowledge of all other communicating objects of the fleet.
2. The method according to claim 1 , wherein the step of locating the fourth communicating object defines only positions of reference objects used to locate the fourth object, the

positions of the three reference objects remain unknown before or after the location of the fourth communicating object.

3. The method according to claim 1, wherein at least one communicating object among the three reference objects is a locating object, the locating object locates the fourth communicating object.
4. The method according to claim 3, wherein the locating object receives, from the other two reference objects, the distances between the fourth communicating object and each of the other two reference objects.
5. The method according to claim 1, wherein a location of the fourth communicating object is obtained by calculating an intersection of at least two orbits where the fourth communicating object are placeable from a point of view of two of the three reference objects.
6. The method according to claim 5, wherein the communicating objects of the fleet is in a plane; wherein an intersection of the orbits of a first reference object and a second reference object comprises two points; and further comprising the step of selecting a point corresponding to the position of the fourth communicating object from said two points whose distance from a third reference object is closest to a value of a radius of the orbit of the third reference object.
7. The method according to claim 5, wherein each communicating object of the fleet has a different altitude; wherein a geometric locus of a placement of the fourth communicating object from the point of view of a first reference object and a second reference object is a sphere; wherein an intersection of two spheres is a nappe; and further comprising the step of selecting a point in the nappe corresponding to the position of the fourth communicating object from points the nappe whose distance from a third reference object is closest to a value of a radius of the orbit of the third reference object.
8. The method according to claim 5, wherein at least two of the three orbits are measured with uncertainty; and further comprising the step of constrained minimization of a

difference between distances of points in an intersection of at least two orbits from a third reference object and a value of the distance of said points from the third reference object.

9. The method according to claim 8, wherein the communicating objects of the fleet is in a plane, wherein the step of constrained minimization comprises the step of calculating an intersection of median circles for each ring forming potential positions of the fourth communicating object, a radius of a middle circle is defined as a historical average of measured radii.
10. The method according claim 9, further comprising the step of dismissing an exceptional measurement in determining the historical average of measured radii by:
 - calculating an absolute average radius from measurements for estimating the distance from the fourth communicating object;
 - dismissing a measurement whose standard deviation is greater than a predetermined threshold, by considering a weight assigned to each measurement according to a signal quality of the said each measurement; and
 - recalculating a relative mean radius based on the remaining measurements.
11. The method according to claim 1, further comprising the iterative step of eliminating the reference objects used to start a process of dynamic localization of the fleet.
12. The method according to claim 11, further comprising the step of locating a fifth communicating object based on the fourth communicating object and two reference objects.
13. The method of claim 12, further comprising the step of locating a sixth communicating object from only one reference object, the fourth communication object and the fifth communicating objects.
14. The method according to claim 13, further comprising the step of locating a subsequent communication object by all or a set of communicating objects whose coordinates are known and said all or set of communication objects do not include the reference objects.

15. The method according to claim 1, further comprising the step of locating the fourth communicating object from a measurement based on only two reference objects in response a determination that a potential position of the fourth communicating object is outside a detection zone, the detection zone is defined by a maximum detection range for the communicating objects of the fleet.
16. The method according to claim 1, further comprising the step of determining a trajectory of a communicating object of the fleet sampled at M sampling instants during a sampling interval when the location of the communicating object is calculated, the sampling interval is defined as a time interval between an initial sampling instant and a final sampling instant.
17. The method according to claim 16, wherein at least one communicating object among the three reference objects is a locating object, the locating object locates the fourth communicating object; wherein the locating object receives from communicating objects in its detection zone information about other communicating objects of the fleet and their positions to provide known communicating objects, the detection zone is defined by a maximum detection range of the locating object; wherein the locating object determines communicating objects capable of measuring their distance from the communicating object whose trajectory is to be determined at a sampling instant, and selects at least two reference objects from the known communicating objects to locate the communicating object whose location is to be determined at the sampling instant.
18. The method according to claim 17, wherein the selection of said at least two reference objects from said known communicating objects to locate the communicating object whose location is to be determined at the sampling instant, is made under a constraint of a list of communicating objects whose locations are known by the locating object at the sampling instant.
19. The method according to claim 16, wherein a time distribution of the sampling instants is linear in the sampling interval and the time distribution controls determination of the M sampling instants.

20. The method according to claim 16, wherein a distribution of the M sampling instants is non-linear in all or part of the sampling interval.
21. The method according to claim 20, wherein the non-linear distribution is defined according to a predefined rule.
22. The method according to claim 20, wherein the non-linear distribution is dynamically determined by external conditions, the external conditions are motion data provided by an accelerometer of the communicating object or a request to establish a trajectory during a sampling sub-interval.
23. The method according to claim 16, wherein the trajectory of the communicating object is obtained by interpolating positions between locations determined at each sampling instant.
24. The method according to claim 23, wherein the positions are interpolated so that the communicating object follows a predefined trajectory; and further comprising the steps of interpolating trajectories using at least one of linear, polynomial, logarithmic and sine interpolation methods; calculating surface areas delimited by two trajectory curves, a predefined or standard trajectory and an interpolated trajectory, and selecting an interpolation method for a corresponding interpolated trajectory that provides a smallest surface area.
25. The method according to claim 1, further comprising the step of initiating at least detection requests and distance measurement requests and directly transmitting detection data and distance measurement data.
26. The method according to claim 1, further comprising the step requesting the communication objects of the fleet to directly transmit a detection data or a distance measurement data to a requesting communicating object.