CLAIMS

1 A system for positioning an object in a zone of interest having a constrained zone, said system comprising:

a set of pseudolites distributed in said constrained zone and each having a spreading code corresponding to the spreading code of a satellite belonging to a constellation of satellites of a satellite navigation system, said constellation of satellites comprising a first set of satellites (S1) and a second set of satellites (S2), with the satellites of the first (S1) and the second (S2) sets of satellites being non-visible from the zone of interest, and the first (S1) and the second (S2) sets of satellites being partially visible such that any one of the satellites (SAT11, SAT12) of the first set (S1) and any one of the satellites (SAT21, SAT22) of the second set (S2) cannot be simultaneously visible from a point located on the surface of the Earth, in the sense that the satellites of the first (SAT11, SAT12) and of the second (SAT21, SAT22) sets have relative positions such that signals transmitted by the satellites (SAT11, SAT12) of the first set (S1) and signals transmitted by the satellites (SAT21, SAT22) of the second set (S2) cannot be received simultaneously by a receiver placed at a point located on the surface of the Earth, each pseudolite also transmitting a positioning signal,

and a receiver located on the object to be localised,

characterised in that the pseudolites are distributed in the constrained zone in such a way that at any point of the constrained zone it is possible for the receiver present on the object to acquire the positioning signals of at least two pseudolites having spreading codes, which for one correspond to a satellite of the first set (S1) and for the other correspond to a satellite of the second set (S2) so that the receiver receiving said positioning signals detects that it is impossible that these are signals transmitted by satellites of the constellation of satellites and consequently determines, in a wholly autonomous manner, that it is receiving positioning signals transmitted by pseudolites.

2. The system according to claim 1, with the constellation of satellites having N sets of satellites, with N being greater than or equal to 3, non-visible from the zone of interest, and with partial visibility, such that any one of the satellites of any one of the N sets of satellites cannot be visible at the same time as any one of the satellites of any one of the other sets of satellites from among the N sets of satellites from a point located on the surface of the Earth, characterised in that the pseudolites are distributed in the constrained zone in such a way that at any point in the constrained zone it is possible for the receiver present on the object to acquire the positioning signals of at least three pseudolites having spreading codes corresponding to satellites belonging to three distinct sets of satellites from among the N sets of satellites.

3. The system according to any one of claims 1 to 2, characterised in that the positioning signals transmitted by the pseudolites broadcast almanachs that are identical to those of the satellites of the constellation of satellites so as to ensure continuity of service upon the transition between a constrained zone provided with a set of pseudolites and an open zone without pseudolites, but allow the reception of positioning signals transmitted by the satellites of the constellation and, at the same time, so as to ensure continuity of service upon the transition between an open zone and a constrained zone.

4. The system according to any one of claims 1 to 3, characterised in that a server connected to the set of pseudolites is configured so as to dynamically assign a matched spreading code to each pseudolite, which spreading code is selected from codes assigned to the satellites that are non-visible from the zone of interest.

5. The system according to any one of the preceding claims, characterised in that the receiver located on the object to be positioned has at least one of the following operating modes:

- a "constrained zone" operating mode when the receiver is located in a zone in which it is likely to only receive positioning signals transmitted by pseudolites;
- an "open zone" operating mode when the receiver is located in a zone in which it is likely to only receive positioning signals transmitted by satellites belonging to a constellation of satellites of a satellite navigation system;
- a "hybrid zone" operating mode when the receiver is located in a zone in which it is likely to receive both positioning signals transmitted by pseudolites and positioning signals transmitted by satellites belonging to a constellation of satellites of a satellite navigation system.

6. The system according to claim 5, characterised in that it is designed to switch from one operating mode to another.

7. The system according to any one of claims 5 to 6, characterised in that the receiver automatically selects its operating mode.

8. The system according to claim 7, characterised in that it comprises means for forcing the operating mode of the receiver.

9. The system according to any one of claims 5 to 6, characterised in that the operating mode of the receiver is manually selected.

CLAIMS

1. A system for positioning an object in a zone of interest presenting a constrained zone, said system including:

a set of pseudolites distributed in said constrained zone and each presenting a spreading code corresponding to the spreading code of a satellite belonging to a constellation of satellites of a satellite navigation system, said constellation of satellites including a first set of satellites (S1) and a second set of satellites (S2), the satellites of the first (S1) and the second (S2) sets of satellites being non-visible from the zone of interest, and the first (S1) and the second (S2) sets of satellites being of disjoint visibility, in such a way that any one of the satellites (SAT11,SAT12) of the first set (S1) and any one of the satellites (SAT21,SAT22) of the second set (S2) cannot be simultaneously visible from a point situated on the surface of the Earth, in the sense that the satellites of the first (SAT11,SAT12) and the second (SAT21,SAT22) sets present relative positions such that signals transmitted by satellites (SAT11,SAT12) of the first set (S1) and signals transmitted by satellites (SAT21,SAT22) of the second set (S2) cannot be received simultaneously by a receiver placed at a point situated on the surface of the Earth, each pseudolite furthermore transmitting a positioning signal,

and a receiver situated on the object to be localized,

characterized in that the pseudolites are distributed in the constrained zone in such a way that, at any point of the constrained zone, it is possible for the receiver of the object to acquire the positioning signals of at least two pseudolites presenting spreading codes corresponding, for the one, to a satellite of the first set (S1), and, for the other, to a satellite of the second set (S2), in such a way that the receiver receiving these positioning signals detects the impossibility of them being signals transmitted by satellites of the constellation of satellites and consequently determines in a totally autonomous manner that it is receiving positioning signals transmitted by pseudolites.

2. The system as claimed in claim 1, the constellation of satellites having N sets of satellites, N been greater than or equal to 3, non-visible from the zone of interest, and of disjoint visibility, in such a way that any one of the satellites of any one of the N sets of satellites cannot be visible at the same time as any one of the satellites of any one of the other sets of satellites among the N sets of satellites from a point situated on the surface of the Earth, characterized in that the pseudolites are distributed in the constrained zone in such a way that, at any point of the constrained zone, it is possible for the receiver of the object to acquire the positioning signals of at least three pseudolites presenting spreading codes corresponding to satellites belonging to three distinct sets of satellites among the N sets of satellites.

3. The system as claimed in any one of claims 1 to 2, characterized in that the positioning signals transmitted by the pseudolites broadcast almanacs identical to those of the satellites of the constellation of satellites, in such a way as to provide a continuity of service at the transition between a constrained zone equipped with a set of pseudolites and an open zone without pseudolites but allowing the reception of positioning signals transmitted by the satellites of the constellation, and, vice versa, in such a way as to provide a continuity of service at the transition between an open zone and a constrained zone.

4. The system as claimed in any one of claims 1 to 3, characterized in that a server connected to the set of pseudolites is configured to allocate dynamically to each pseudolite a suitable spreading code chosen from codes allocated to the satellites that are non-visible from the zone of interest.

5. The system as claimed in any one of the preceding claims, characterized in that the receiver situated on the object to be positioned presents at least one of the following operating modes:

- a "constrained zone" operating mode when the receiver is located in a zone in which it is able to receive only positioning signals transmitted by pseudolites;
- an "open zone" operating mode when the receiver is located in a zone in which it is able to receive only positioning signals transmitted by satellites belonging to a constellation of satellites of a satellite navigation system;
- a "hybrid zone" operating mode when the receiver is located in a zone in which it is able to receive both positioning signals transmitted by pseudolites and positioning signals transmitted by satellites belonging to a constellation of satellites of a satellite navigation system.

6. The system as claimed in claim 5, characterized in that it is suitable for switching from one operating mode to another.

7. The system as claimed in one of claims 5 to 6, characterized in that the receiver selects its operating mode in an automatic manner.

8. The system as claimed in claim 7, characterized in that it includes means to force the operating mode of the receiver.

9. The system as claimed in one of claims 5 to 6, characterized in that the operating mode of the receiver is chosen manually.