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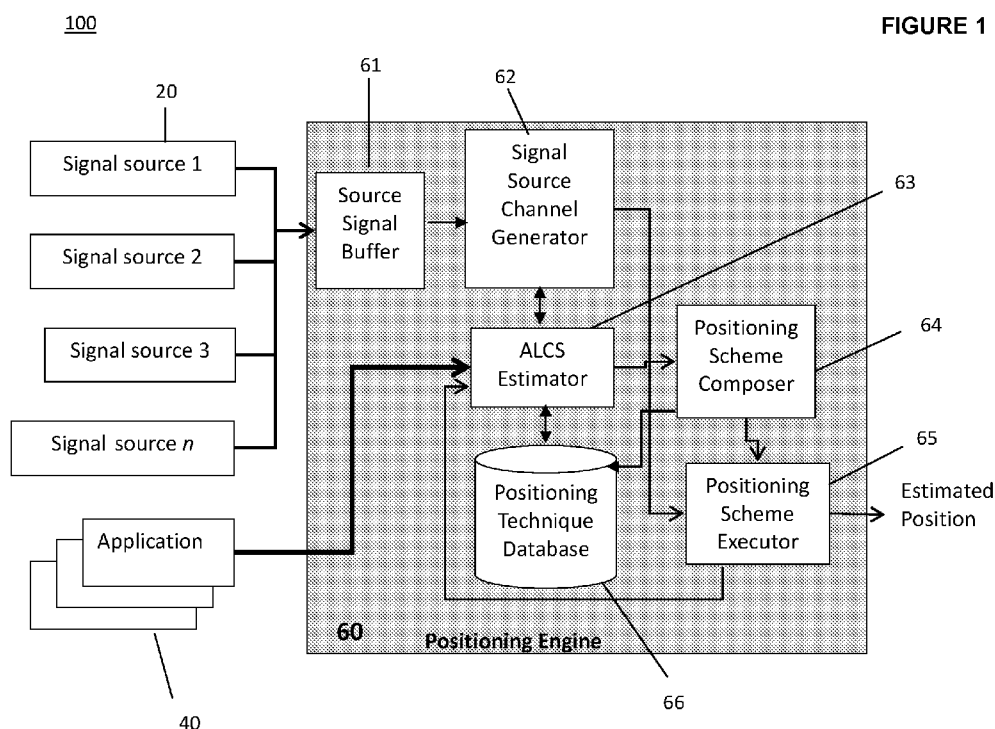
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(54) Title: SYSTEM AND METHOD FOR ESTIMATING GEOSPATIAL POSITION BY COMPOSING POSITIONING SCHEME



(57) Abstract: The present invention discloses a system for estimating geospatial position by composing positioning scheme from a plurality of signal sources (20) using at least one positioning technique comprising of a positioning engine (60), whereby the positioning engine (60) further comprising a source signal buffer (61); a signal source channel generator (62); an application level constraint specification, ALCS estimator (63); a positioning scheme composer (64); a positioning scheme executor (65) and a positioning technique database (66). Further, the method of estimating geospatial position by composing position estimation scheme from the plurality of signal sources (20) using at least one positioning technique are provided herein to perform the same.

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SYSTEM AND METHOD FOR ESTIMATING GEOSPATIAL POSITION BY COMPOSING POSITIONING SCHEME

FIELD OF THE INVENTION

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The present invention generally relates to estimate position, and more particularly relates to a system and method for estimating geospatial position by composing a geospatial positioning scheme and returning the estimated position to an application.

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BACKGROUND OF THE INVENTION

Recently, wireless communication technology is the fastest active technology in a field of communication development. As the demands of wireless technology rising in our daily lives, the developments in this technology has increased rapidly. Such application in wireless technology that are important nowadays is on estimating position of user location. Different wireless networks typically employs different positioning techniques. Currently, the most widely used positioning technique is based on GPS satellite signals. However, the GPS satellite positioning technique only suitable for outdoor environment.

For an indoor location, it is generally more viable to estimate the position using WiFi or Bluetooth Low Energy (BLE) signals. Some other techniques rely on built-in sensors on a device such as magnetometer, accelerometer, gyroscope, and etc. The techniques that rely on the built-in sensor might not be a good positioning technique by itself or at least when performing the initial position estimation, but is often regarded as a good means to enhance the accuracy of other positioning techniques such as GPS-based or WiFi-based. While seamless positioning is possible when an object moves between different environments such as between indoor and outdoor, it is a challenge to decide which technique or combination of techniques to be used at that instance as the environment boundary is not discrete.

An example of patent application that relates to a positioning method is disclosed in China patent application, CN 101772156 A. The invention provides a

positioning method and a positioning device of a WLAN (wireless local area network). The method comprises the following steps of sampling the wireless network signal, including establishing the coordinate system of to-be-positioned area, extracting the signal strength of each coordinate point in the coordinate system of the to-be-positioned area, and calculating the distribution rule and the characteristic value of the signal strength of the coordinate points. The method further comprising the steps of positioning the WLAN device, including receiving the measurement data of the WLAN device and finally, calculating the geographical coordinates of the WLAN device according to the distribution rule and the characteristic value of the signal strength of the coordinate points as well as the measurement data of the WLAN device.

Another patent that defines the positioning techniques between different environment is disclosed in Korean patent, KR 101616720 B1. The patent defines about a mixing zone of a signal including a potted continuous position estimation system and relates to its method of operation. The outdoor section estimate position for the GPS signal with the indoor section located WiFi, ZigBee, NFC, or a combination thereof for the estimation. There is an effect that the user to compensate by monitoring the radio reception environment according to movement of the user suddenly changes as it moves in the mixing section, so as to seamlessly continuous position estimation possible.

Therefore, there is a need for an improved a system and method for estimating a geospatial position by composing a positioning scheme from a plurality of signal sources using at least one positioning technique. Although there are systems and methods for the same in the prior arts, for many practical purposes, there is still considerable room for improvements.

SUMMARY OF THE INVENTION

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The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented later.

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It is an object of the present invention to provide a system and method to estimate position between a different environment such as between indoor and outdoor.

Another objective of the present invention is to compose and provide positioning
5 scheme based on quality status of signal data within the different environment in order to estimate the position.

Accordingly, the present invention provides a system for estimating a geospatial position by composing a geospatial positioning scheme from a plurality of signal
10 sources using at least one positioning. The system comprising of a positioning engine configured for receiving a plurality of signal data from the plurality of signal sources and receiving positioning request from at least an application. The positioning engine is characterized by a source signal buffer configured for retrieving the plurality of signal data from the plurality of signal sources; a signal
15 source channel generator configured for assigning channel health status of the plurality of signal data from the source signal buffer; an application level constraint specification, ALCS estimator configured for receiving the positioning request from the application and estimating outcome for elements of the ALCS based on the channel health status for the plurality of signal data from the signal source channel
20 generator; a positioning scheme composer configured for composing positioning scheme based on the estimated outcome of the ALCS elements; and a positioning scheme executor configured for executing the composed positioning scheme from the positioning scheme composer and computing the estimated position to the requested application.

25 Preferably, the positioning engine further comprising a positioning technique database for storing the at least one of the positioning technique in form of scheme building block.

30 Preferably, the source signal buffer further configured for grouping the plurality of signal data in batch format according to a predefined time interval and assigning a time stamp to each of the batch format.

Preferably, the channel health status is a form of quality indication for a particular
35 signal type when applied to a specific positioning technique.

Preferably, ALCS estimates outcome for the elements of the ALCS by computing value of average positioning accuracy level, AL and value of average computation time, CT.

- 5 Preferably, the positioning scheme composer composing positioning scheme by applying ALCS filtering, proposing a list of positioning technique schemes and applying weightage to the proposed list of positioning technique schemes.

10 In accordance with another aspect of the present invention, a method of estimating a geospatial position by composing positioning scheme from a plurality of signal sources using at least one positioning technique is provided.

The method of the present invention comprises the steps of retrieving a plurality of signals data from the plurality of signal sources by a signal source buffer;
15 assigning channel health status for the plurality of signals data by a signal source channel generator; estimating outcome of application level constraint specification, ALCS elements values based on the channel health status by an application level constraint specification, ALCS estimator, wherein the ALCS elements are accuracy level of application and computation time; composing
20 positioning scheme based on the estimated outcome of the ALCS elements values by a positioning scheme composer; executing the composed positioning scheme from the positioning scheme composer by a positioning scheme executor; and estimating the geospatial position based on the composed positioning scheme by the positioning scheme executor.

25 Preferably, the method of assigning channel health status for the plurality of signals data by a signal source channel generator further comprising the steps of identifying status of the plurality of signals data against the predefined time interval or batch time-period and a predefined threshold; filtering the batch data, if
30 the data met criteria; processing statistical to the data; and assigning channel health status indicator to the signals data based on outcome of the filtering and processing statistical.

Preferably, the method of estimating outcome of the ALCS elements values based
35 on the channel health status by an application level constraint specification, ALCS

estimator further comprising the steps of extracting ALCS elements from at least an application; sweeping signal source channel for channel availability and channel health status; recommending a list of positioning techniques for each of the signal source channel; executing the list of recommended positioning techniques; obtaining initial estimated values for the ALCS elements for each of the techniques; and storing initial estimated of the ALCS elements values in a positioning technique database.

Preferably, the method of the composing positioning scheme based on the estimated outcome of the ALCS elements values by a positioning scheme composer further comprising the steps of performing preliminary filtering according to ALCS elements values; proposing a list of positioning technique schemes; and applying weightages to the estimated outcomes of the ALCS elements values.

The foregoing and other objects, features, aspects and advantages of the present invention will become better understood from a careful reading of a detailed description provided herein below with appropriate reference to the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Figure 1 illustrates a block diagram of a system for estimated geospatial position by composing positioning scheme according to one embodiment of the present invention.

Figure 2a illustrates a signal source obtained in a uniform nature according to one embodiment of the present invention.

Figure 2b illustrates a signal source obtained in a non-uniform nature according to one embodiment of the present invention.

Figure 3a- 3f illustrates examples of positioning technique scheme building block
5 according to one embodiment of the present invention.

Figure 4 illustrates a flowchart of a method of estimating geospatial position by composing positioning scheme according to one embodiment of the present invention.
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Figure 5 illustrates a flowchart of the sub-steps of assigning signal health status for a plurality of signals data by a signal source channel according to one embodiment of the present invention.

Figure 6 illustrates a flowchart of the sub-steps of estimating outcome of application level constraint specification (ALCS) elements according to one embodiment of the present invention.
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Figure 7 illustrates a flowchart of the sub-steps of composing positioning scheme according to one embodiment of the present invention.
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It is noted that the drawings may not be to scale. The drawings are intended to depict only typical aspects of the invention, and therefore should not be considered as limiting the scope of the invention. In the drawings, like
25 numberings represent like elements between the drawings.

DETAILED DESCRIPTION OF THE INVENTION

The above mentioned features and objectives of this invention will become
30 more apparent and better understood by reference to the following detailed description. It should be understood that the detailed description made known below is not intended to be exhaustive or limit the invention to the precise disclosed form, as the invention may assume various alternative forms. On the contrary, the detailed description covers all the relevant modifications and

alterations made to the present invention, unless the claims expressly state otherwise.

The present invention provides a system and method for estimating
5 geospatial position by composing position estimation scheme. The geospatial position between different environments such as between indoor and outdoor is difficult to be estimated due to the environment boundaries that is not discrete and the position estimation scheme technique proposed in defining the position is complex. Hence, the system and method provided in the present invention may
10 help in providing the geospatial position requested by an application as well as composing position estimation scheme technique.

Initial reference made to FIG. 1 illustrates a block diagram of the system (100) for estimating a geospatial position by composing positioning scheme
15 according to an embodiment of the present invention. The system (100) for estimating the geospatial position from a plurality of signal sources (20) comprises of a positioning engine (60), whereby the positioning engine (60) configured for receiving a plurality of signals data from the plurality of signal sources (20) and receiving positioning request from at least an application (40). The application (40)
20 preferably refer to the applications that used location information in particular geospatial coordinate, such as shopping mall navigation, parking navigation, museum navigation, hospital navigation, etc. The signal sources (20) can be acquired from a device communication or network interfaces, preferably but not limited to global positioning system (GPS), global system for mobile
25 communication (GSM), 3G, LTE, WiFi, bluetooth or built in sensors such as magnetometer, accelerometer, gyrometer, barometer and etc.

The positioning engine (60) further comprising of a source signal buffer (61), signal source channel generator (62), an application level constraint
30 specification (ALCS) estimator (63), a positioning scheme composer (64), a positioning scheme executor (65), and a positioning technique database (66). The source signal buffer (61) which is connected to the signal source channel generator (62) is configured for retrieving the plurality of signals data from the plurality of signal source (20). The plurality of signals data produced by sources
35 (20) such as GPS, WiFi, Bluetooth Low Energy (BLE) sensor, etc are preferably in

raw format and comprises a lot of information. However, only a desired information are required such as latlong, accuracy for GPS, MAC address, SSID and RSSI for positioning computation. The raw data format is then grouped in form of batches according to a predefined time interval, i.e. batch time-period and subsequently a time stamp is assigned to each of the batch time-period.

Requirement for each of the batch time-period is different between different signal sources. Preferably, some of the signals data can be obtained in fixed interval, i.e. in a uniform nature, while some of the other data can be obtained in an unfixed interval, i.e. non-uniform nature. Figure 2a shows the notion of raw batch-data and batch-time obtained in uniform nature from signal source 1, while Figure 2b shows the notion of raw batch-data and batch-time obtained in non-uniform nature from signal source 2. The batch data will be stored in the source signal buffer (61).

The signal source channel generator (62) is connected to the source signal buffer (61), the ALCS estimator (63) and the positioning scheme executor (65). The plurality of signal data from source signal buffer (61) are being retrieved by the signal source channel generator (62) to further identify a quality of the data. The quality of signal data will be identified based on the predefined time interval or batch time-period and a predefined threshold. As an example, if the number of the retrieved signal data is lesser than value of the predefined time interval or batch time-period, the source channel will be set as not available. The source channel also will be marked as not available if the signal magnitude of the data is lower than certain predefined threshold, e.g. signal strength less than 90dBm.

If the signal data identified to be met criteria i.e. the retrieved signal data is more than value of the predefined time interval and predefined threshold, then the signal source channel generator (62) set the signal data as a qualified signal data to be used for geospatial positioning in a subsequent process. The signal source channel generator (62) will further configured to perform signal filtering and statistical processing to the qualified signal data. Such signal filtering preferably but not limited to smoothing, averaging, high or low pass filtering. While for statistical processing, the process is preferably but not limited to mean, max, min,

standard deviation, variance, and other standard statistical data processing method. The data subsequently will be stored in a post-processed signal buffer.

Further to above identification, the signal data that are qualified over the predefined time interval and predefined threshold will be indicated as a signal health status on each of the signal source channel. The signal source channel that having the signal health status will be associated with a channel health status, whereby the channel health status value may range from 0 to 10 with 0 value is presumed as a source channel that are not available, value of 1 is presumed as a least healthy though available, while value of 10 is presumed as the most healthiest channel available. The signal health defined in the present invention is a form of quality indication of a particular type of signal when applied to a specific positioning technique.

The application level constraint specification, (ALCS) estimator (63) as shown in figure 1 is connected to the signal source channel generator (62), the positioning scheme composer (64), the positioning technique database (66) and to the at least an application (40). The ALCS estimator (63) received a positioning request from at least an application (40), whereby the at least an application (40) preference consists of accuracy level (AL) and computation time (CT). The AL and CT provided by the application (40) will be regarded as elements of the ALCS during subsequent process. Based on the availability of the channel health status, a list of positioning techniques are recommended to the ALCS estimator (63) by the positioning technique database (66). When performing an initial ALCS estimation, the ALCS estimator (63) need to retrieve positioning technique information from the database (66). For example, when WiFi data channel is available, a positioning technique for WiFi is executed. Same goes if GPS channel is available, the GPS technique invoked and the channel health status values subsequently may influence the accuracy level and computation time of the selected technique. The ALCS estimator (63) preferably compute to estimate a value of average positioning accuracy level for each applicable technique in selected unit such as meter. Further on that, the ALCS estimator also compute to estimate a value of average computation time in selected unit such as second. A constraint equation to compute which technique is applicable is defined as following equation:

ALCS $\{AL \leq 5 | w_i = 7\}$, $CT \leq 5 | w_j = 3\}$; whereby

ALCS = Application level constraint specification;

AL = Accuracy level;

5 CT = Computation time;

w_i, w_j = weightage;

10 An example for estimating the initial performance on the ALCS elements by the ALCS estimator (63) based on the channel health status value shown as following table 1. The signal source channel (SSC) with channel health status value are defined in below table preferably represented as following:

SSC1 = 5 (medium);

SSC2 = 0 (not available);

SSC3 = 8 (good);

15 SSC4 = 0 (not available); and

SSC5 = 10 (excellent)

whereby each of the signal source channel (SSC) preferably represent for following example sources;

SSC1 preferably as a GPS;

20 SSC2 preferably as a GSM based positioning;

SSC3 preferably as a WiFi;

SSC4 preferably as a Bluetooth; and

SSC5 preferably as a magnetometer sensor.

Signal Source Channel	Channel Health (CH)	Technique	Estimated AL (average in meter)	Estimated CT (average in second)	Condition
1	5	A1	15	1	Only CT fulfils
1	5	A2	20	1	Only CT fulfils
2	0	-	-	-	Channel not available
3	8	C1	10	3	Only CT fulfils
3	8	C2	7	5	Only CT fulfils
3	8	C3	5	8	Only AL fulfils

4	0	-	-	-	Channel not available
5	10	E1	(2)*	3	*Need C1, C2 or C3 to perform initial estimation on accuracy
5	10	E2	(3)*	2	*Need C1, C2 or C3 to perform initial estimation on accuracy

Table 1: Example of initial estimation of ALCS elements outcome by the ALCS estimator (63) based on signal source channel health status.

5 From the table 1, recommended technique A and C can operate independently, while technique E on the other hand is dependent on technique C in order to achieve the estimated accuracy. The table 1 show an initial outcome (first iteration) of the positioning estimation. The initial AL and CT values estimation with respect to channel health status value are precomputed and
10 stored in the positioning technique database (66). The technique that fulfill the requirement given by the application will be determined based on the ALCS constraint equation.

Upon obtaining the initial estimation of ALCS elements outcome from table
15 1, the positioning scheme composer (64) configured to compose a positioning scheme based on the estimated outcome of the ALCS elements from the ALCS estimator (63). To compose the positioning scheme, the positioning scheme composer (64) further configured to perform preliminary filtering, proposing positioning technique scheme, and applying weightage to the estimated AL and
20 CT values.

Preliminary filtering will be performed according to the ALCS values through an iterative manner selecting process under certain value of conditions. Such condition is preferably either a list of technique achieving partial ALCS
25 fulfilment such as only CT fulfilling given constraint while observing max tolerance

on AL, or only AL fulfilling given constraint while observing max tolerance on CT, or both AL & CT not fulfilling given constraints but still fall within certain tolerance from the constraint limits. Table 2 below shows a result of ALCS estimator (63) based on the preliminary filtering according to the present invention.

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Signal Source Channel	Channel Health (CH)	Technique (applicable)	Estimated AL (average in meter)	Estimated CT (average in second)	Remark
3	8	C2	7	5	
3	8	C3	5	6	
5	10	E1	2	3	*Require C1, C2 or C3 to perform initial estimation
5	10	E2	3	2	*Require C1, C2 or C3 to perform initial estimation

Table 2: Result of ALCS Estimator Preliminary Filtering

From table 2, only 4 out of 7 initial shortlisted techniques are applicable upon the preliminary filtering.

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Once the preliminary filtering is performed, a list of positioning technique schemes that fulfilled all ALCS constraints are proposed after analyzing the list. A general example of positioning scheme is shown in Figure 3a. Referring to Figure 3a, an acceptable input type of the scheme is either input SSC only or input SSC and position. Figure 3b shows an example of scheme technique A, whereby the technique A do not necessarily take input from SSC. It may take position estimation output from other technique as an input. Example scheme shown as in Figure 3c comprises of technique B which having an input signal from SSC, estimated output position and CT period. Example of another scheme that are

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referred to Figure 3d to 3f are preferably list of positioning technique scheme that having chained formations in series such in Figure 3d, chained formations in parallel referred to Figure 3e and joint series & parallel chain formations as in Figure 3f respectively. Table 3 as below shows a result of scheme composer based on list of proposed positioning technique.

SSC	Channel Health (CH)	Technique (applicable)	Estimated AL (average in meter)	Estimated CT (average in second)	Remark
3,5	8,10	C3 then E1	2	3	Positioning 1
3,5	8,10	C3 then E2	3	2	Positioning 2

Table 3: Result of Scheme Composer based on list of proposed positioning technique.

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Based on table 2, technique C3 and E1/E2 are combined in order to produce two positioning scheme as shown as above table 3. From table 3, the scheme can meet the AL and CT constraint defined in the ALCS.

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Once the positioning technique scheme is composed, a weightage is applied to the estimated value of AL and CT based on the proposed positioning technique scheme in order to select the best positioning scheme according to the application (40) requirement. Different applications (40) requires different level of accuracy level and computation time.

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For example when performing a typical location-based advertisement in a retail environment, an accuracy requirement of around 5 to 10m might be acceptable within around 5s position computation time as the person is unlikely to walk too far after 5s. However when viewing an exhibit in a museum, sub meter of 2m accuracy is required even with a slightly longer computation or waiting time. On the other hand, such as navigation guide for a visual impaired will require a higher level of accuracy such as sub meter 1m accuracy and shorter computation time such as computation time in fraction of second.

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Table 4 below shows a result of the scheme composer final recommendation after the weightage selection process. From table 3, after applying the weightage, the final scheme selected the technique C3 and the technique E1.

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SSC	Channel Health (CH)	Technique (applicable)	Estimated AL (average in meter)	Estimated CT (average in second)	Remark
3,5	8,10	C3 then E1	2	3	Positioning 1

Table 4: Result of Scheme Composer Final Recommendation after weightage selection.

The composed positioning technique obtained from the positioning scheme composer (64) used in the positioning scheme executor (65) to draw a real-time data from the signal source channel. The positioning scheme executor (65) will execute the composed or selected positioning scheme and subsequently computes the estimated position in a required format such as in two spatial dimensions (x,y) or three spatial dimensions (x,y,z). Alternatively, a desired position can be represented by a representative location ID such as "ID147323=Room1", ID313431=meeting room2, and etc. The positioning scheme executor (65) also will trigger a new composition technique upon detecting a significant change in the channel health condition.

The positioning scheme composer (64) retrieves pre-composed positioning scheme from positioning technique database (66). Some examples of pre-composed positioning schemes are shown in forms of building blocks in figure 3a to 3f. Each scheme is associated with an empirical performance data.

An example performance data is "if CH=x, then using scheme C1+E1, the AL=y, CT=z". Such data is obtained from past experiment or historical data collected which either obtained in real-time or non real-time manner. Each of the positioning technique scheme building blocks specified the form of input type and output of the position estimation.

In one of a preferred embodiment, a method (1000) of estimating the geospatial position by composing positioning scheme from the plurality of signal sources (20) using at least one positioning technique is performed as in Figure 4. The method of estimating the geospatial position requested by at least an application (40) is performed by retrieving (1100) the plurality of signals data from the plurality of signal sources (20) by the signal source buffer (61). The at least an application (40) request for a spatial position signal data to the positioning engine (60) with the application-defined constraint specification elements which comprises of desired computation time and accuracy level. Each of the constraint specification elements assigned with a weightage respectively.

The plurality of signals data from the signal source buffer (61) is then be assigned (1200) with a health status, preferably as a channel health status by the signal source channel generator (62). Based on the channel health status, outcome of the application level constraint specification (ALCS) elements values are estimated (1300) by the ALCS estimator (63), wherein the ALCS elements preferably are accuracy level of application and computation time. The estimated outcome of the ALCS elements value then be use for composing a positioning scheme (1400) by the positioning scheme composer (64). The positioning scheme executor (65) further executing the composed positioning scheme (1500) to estimate (1600) the geospatial position requested by the at least an application (40). Additionally, if there is any significant changes on the channel health condition and channel availability, the position scheme executor (65) will trigger a new composition process.

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Further method to perform assigning (1200) channel health status to the plurality of signals data by the signal source channel generator (62) is shown as in Figure 5. The method comprises the steps of identifying quality of the plurality of signals data against the predefined time interval or batch time-period and a predefined threshold (1210). If the number of the retrieved signals data sample is lesser than value of the predefined time interval or batch time-period, the source channel will be set as not available. The source channel also will be marked as not available if the signal magnitude of the data is lower than certain predefined threshold, e.g. signal strength less than 90dBm. The process then will be ended.

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However, if the number of the retrieved signals data sample and the signal magnitude of the data is higher than the predefined time interval or predefined threshold, the quality of the data is considered to be met the criteria and the batch of data will be filtered (1220). A statistical process will be performed to the filtering data (1230). Such signal filtering preferably but not limited to smoothing, averaging, high or low pass filtering. While for statistical processing, the process is preferably but not limited to mean, max, min, standard deviation, variance, and other common statistical data processing method that required by each type of the signal source such as GPS, GSM, WiFi, etc. Based on the outcome of the filtering process and statistical process, a channel health status will be assigned to the plurality of the signal source (1240).

Referring to Figure 6, the method of estimating (1300) outcome of the ALCS elements values based on the channel health status by an application level constraint specification, ALCS estimator (63) is performed herein. The ALCS elements are extracted (1310) from the at least an application (40). The signal source channel (SSC) is sweeping for channel availability and channel health status (1320). The sweeping means checking the signal source channel one by one. One sweep is equal to one cycle through all SSCs to acquire the CH values of each SSC for subsequent process.

Further step then, a list of positioning techniques is recommended for each of the signal source channel (1330) and subsequently the recommended list of the positioning techniques will be executed (1340) for each of the signal source channel. Based on each of the technique executed in prior step, initial estimated values for the ALCS elements are obtained (1350). The initial estimated of the ALCS elements values then stored (1360) in the positioning technique database (66).

Figure 7 shows the method of composing positioning scheme (1400) based on the estimated outcome of the ALCS elements values by a positioning scheme composer (64). The method comprising the steps of performing preliminary filtering according to ALCS elements values (1410). The preliminary filtering will be performed according to the ALCS values through an iterative manner selecting process under certain value of conditions. Such condition is

preferably either a list of technique achieving partial ALCS fulfilment such as only CT fulfilling given constraint while observing max tolerance on AL, or only AL fulfilling given constraint while observing max tolerance on CT, or both AL & CT not fulfilling given constraints but still fall within certain tolerance from the
5 constraint limits.

Then, a list of positioning schemes that fulfilled all the ALCS elements are proposed (1420). The list of positioning scheme is preferably but not limited to list of positioning technique scheme that having chained formations in series, chained
10 formations in parallel, and joint series & parallel chain formations. A weightage will be applied to the estimated AL and CT values based on the proposed positioning technique scheme (1430) in order to select the best positioning scheme according to the application's requirement.

15 The terms "a" and "an," as used herein, are defined as one or more than one. The term "plurality," as used herein, is defined as two or more than two. The term "another," as used herein, is defined as at least a second or more. The terms "including" and/or "having," as used herein, are defined as comprising (i.e., open language).

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While this invention has been particularly shown and described with reference to the exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention as defined by the appended
25 claims.

CLAIMS

1. A system **(100)** for estimating a geospatial position by composing position estimation scheme from a plurality of signal sources (20) using at least one positioning technique comprising of:
 - a positioning engine (60) configured for receiving a plurality of signal data from the plurality of signal sources (20) and receiving positioning request from at least an application (40),
 - characterised in that the positioning engine (60) further comprising:
 - a source signal buffer (61) configured for retrieving the plurality of signals data from the plurality of signal sources (20);
 - a signal source channel generator (62) configured for assigning channel health status for the plurality of signals data from the source signal buffer (61);
 - an application level constraint specification, ALCS estimator (63) configured for receiving the positioning request from the at least an application (40) and estimating outcome for elements of the ALCS based on the channel health status of the plurality of signals data from the signal source channel generator (62);
 - a positioning scheme composer (64) configured for composing positioning scheme based on the estimated outcome of the ALCS elements; and
 - a positioning scheme executor (65) configured for executing the composed positioning scheme from the positioning scheme composer (64) and computing the estimated position to the requested application (40).
2. The system **(100)** according to claim 1, wherein the positioning engine (60) further comprising a positioning technique database (66) for storing the at least one of the positioning technique in form of scheme building block.
3. The system **(100)** according to claim 1, wherein the source signal buffer (61) further configured for grouping the plurality of signals data in batch format according to a predefined time interval and assigning a time stamp to each of the batch format.

4. The system **(100)** according to claim 1, wherein the channel health status is a form of quality indication for a particular signal type when applied to a specific positioning technique.
5. The system **(100)** according to claim 1, wherein the ALCS estimator (63) estimates outcome for the elements of the ALCS by computing value of average positioning accuracy level, AL and value of average computation time, CT.
6. The system **(100)** according to claim 1, wherein the positioning scheme composer (64) composing positioning scheme by applying ALCS filtering, proposing a list of positioning technique schemes and applying weightage to the proposed list of positioning technique schemes.
7. A method **(1000)** of estimating a geospatial position by composing position estimation scheme from a plurality of signal sources (20) using at least one positioning technique is characterized by the steps of:
 - retrieving (1100) a plurality of signals data from the plurality of signal sources (20) by a signal source buffer (61);
 - assigning (1200) channel health status for the plurality of signals data by a signal source channel generator (62);
 - estimating (1300) outcome of application level constraint specification, ALCS elements values based on the channel health status by an application level constraint specification, ALCS estimator (63), wherein the ALCS elements are accuracy level of application and computation time;
 - composing positioning scheme (1400) based on the estimated outcome of the ALCS elements values by a positioning scheme composer (64);
 - executing the composed positioning scheme (1500) from the positioning scheme composer (64) by a positioning scheme executor (65); and
 - estimating the geospatial position based on the composed positioning scheme (1600) by the positioning scheme executor (65).

8. The method (1000) according to claim 7, wherein the assigning (1200) channel health status for the plurality of signals data by a signal source channel generator (62) further comprising the steps of :
- 5 identifying status of the plurality of signals data against the predefined time interval or batch time-period and a predefined threshold (1210);
- filtering the batch data, if the data met criteria (1220);
- processing statistical to the data (1230); and
- 10 assigning channel health status indicator to the signal data based on outcome of the filtering and processing statistical (1240).
9. The method (1000) according to claim 7, wherein the estimating (1300) outcome of the ALCS elements values based on the channel health status by an application level constraint specification, ALCS estimator (63) further
- 15 comprising the steps of:
- extracting (1310) ALCS elements from at least an application (40);
- sweeping signal source channel for channel availability and channel health status (1320);
- 20 recommending (1330) a list of positioning techniques for each of the signal source channel;
- executing (1340) the list of recommended positioning techniques;
- obtaining (1350) initial estimated values for the ALCS elements for each of the techniques; and
- 25 storing (1360) initial estimated of the ALCS elements values in a positioning technique database (66).
10. The method (1000) according to claim 7, wherein the composing positioning scheme (1400) based on the estimated outcome of the ALCS elements values by a positioning scheme composer (64) further
- 30 comprising the steps of:
- performing preliminary filtering according to ALCS elements values (1410);
- proposing a list of positioning technique schemes (1420); and
- 35 applying weightages to the estimated outcomes of the ALCS elements values (1430).

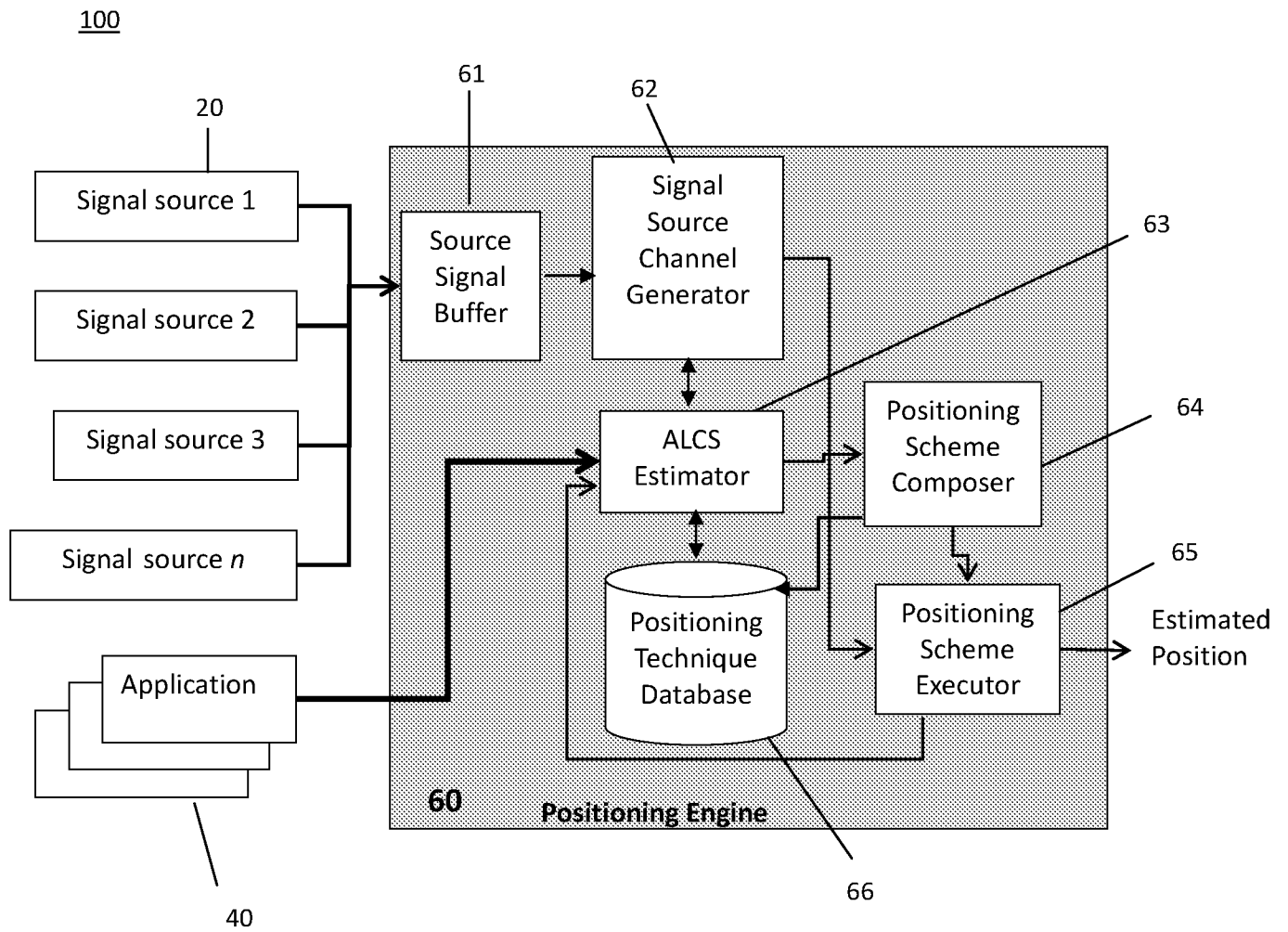


FIGURE 1

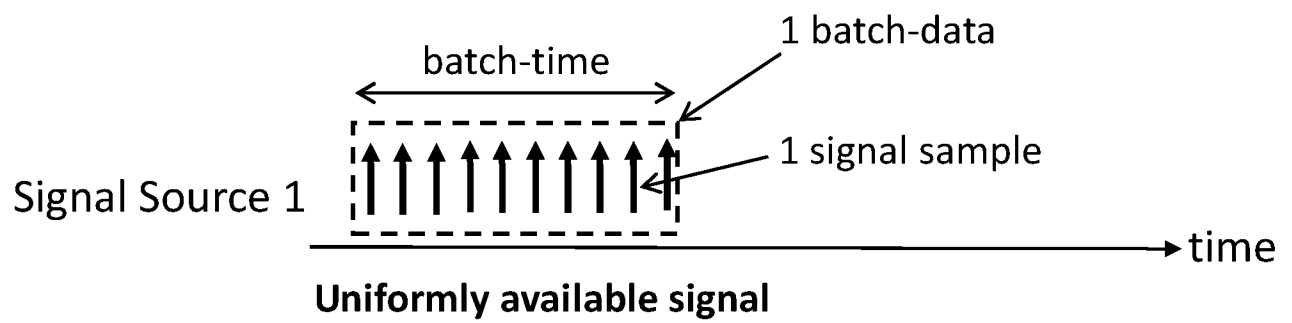


FIGURE 2a

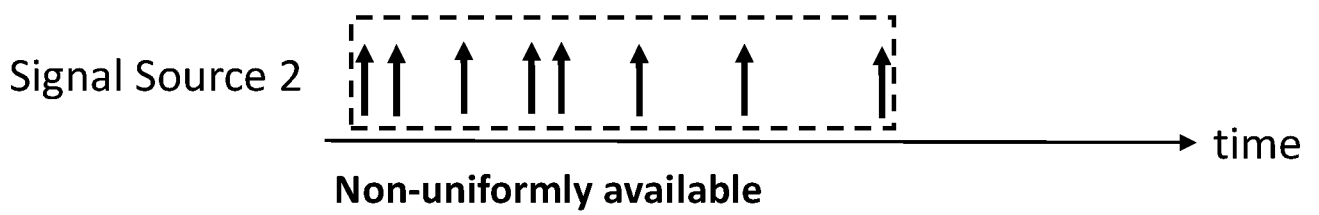
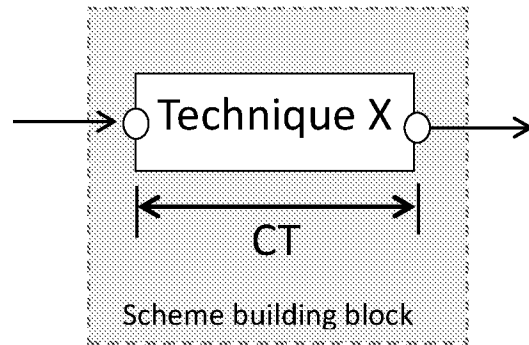
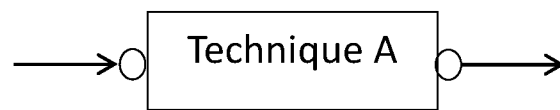
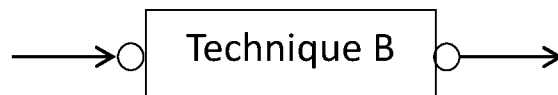
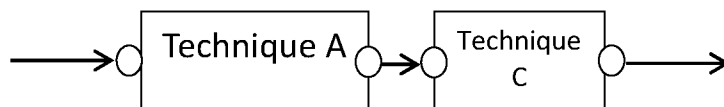


FIGURE 2b

**FIGURE 3a****FIGURE 3b****FIGURE 3c****FIGURE 3d**

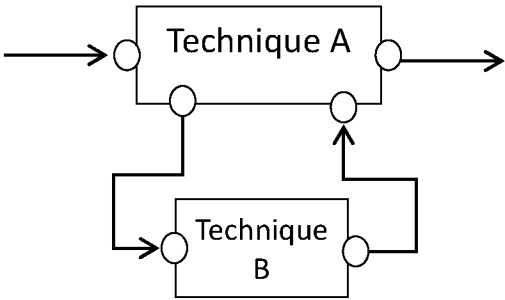


FIGURE 3e

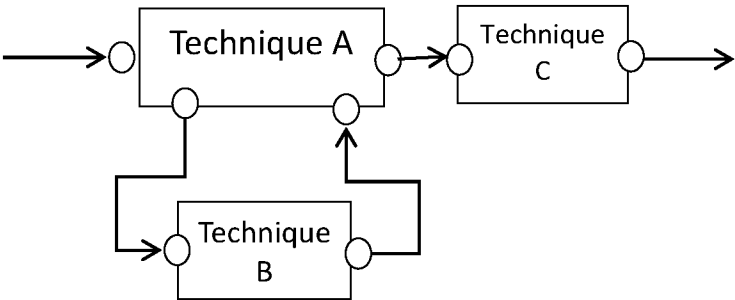


FIGURE 3f

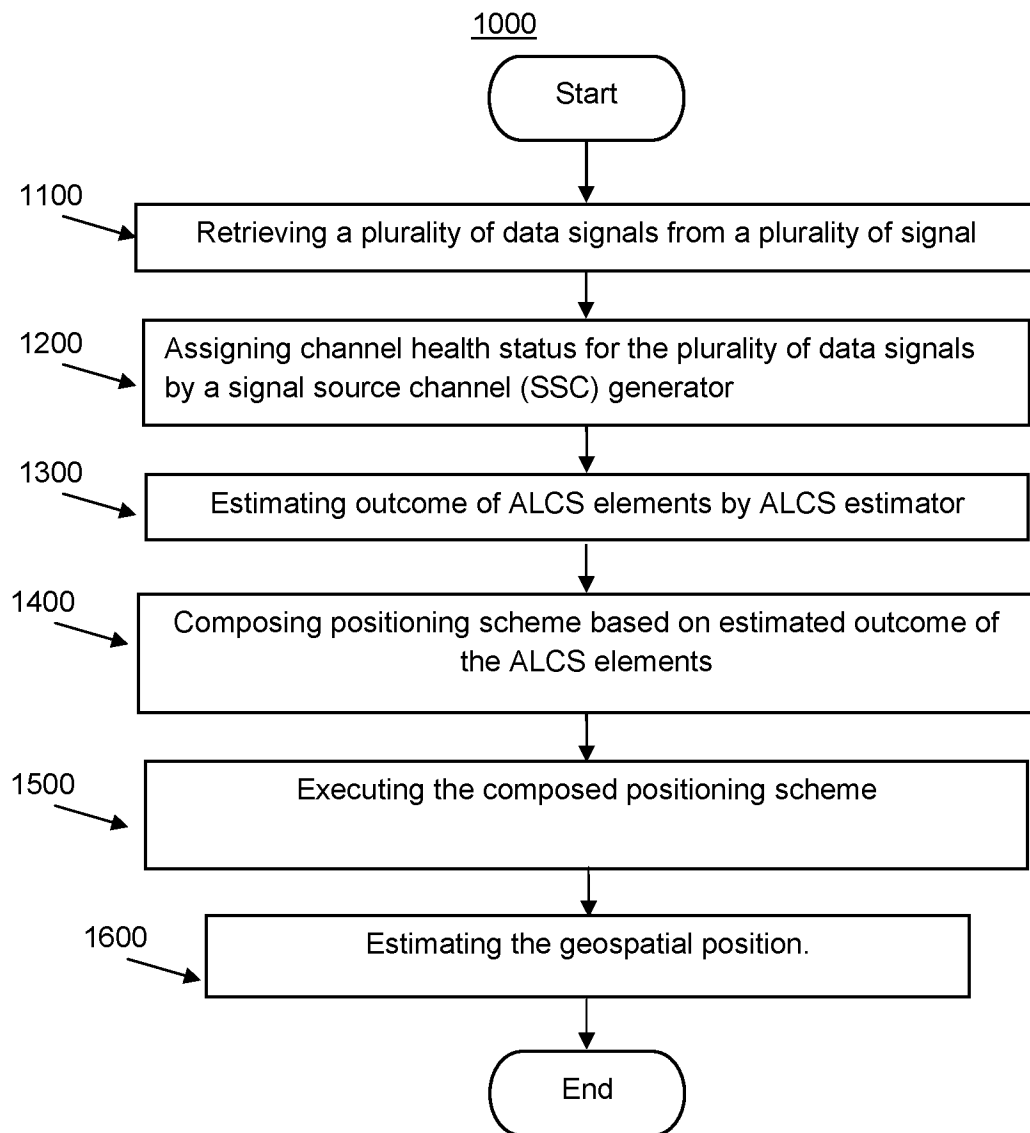


FIGURE 4

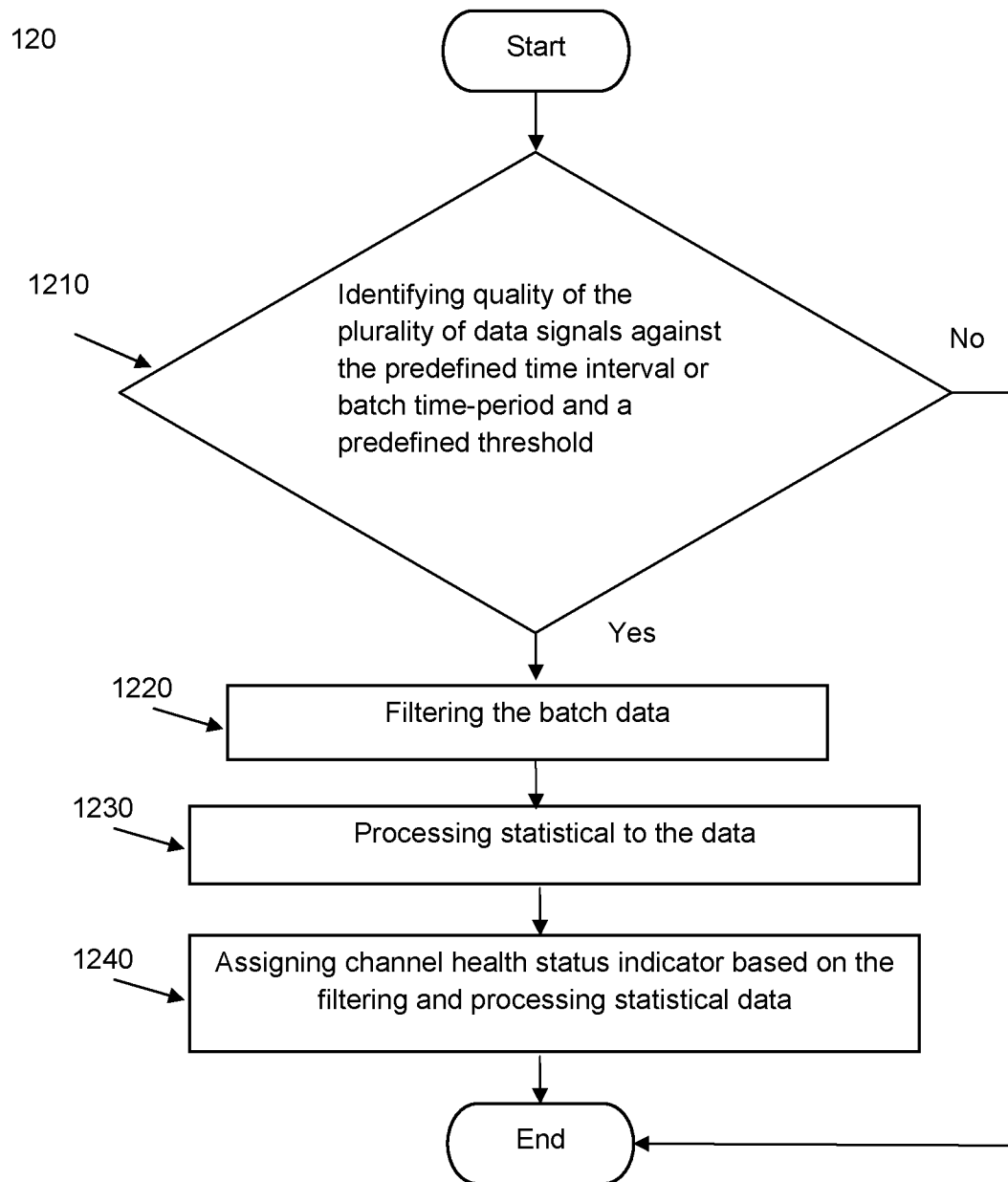
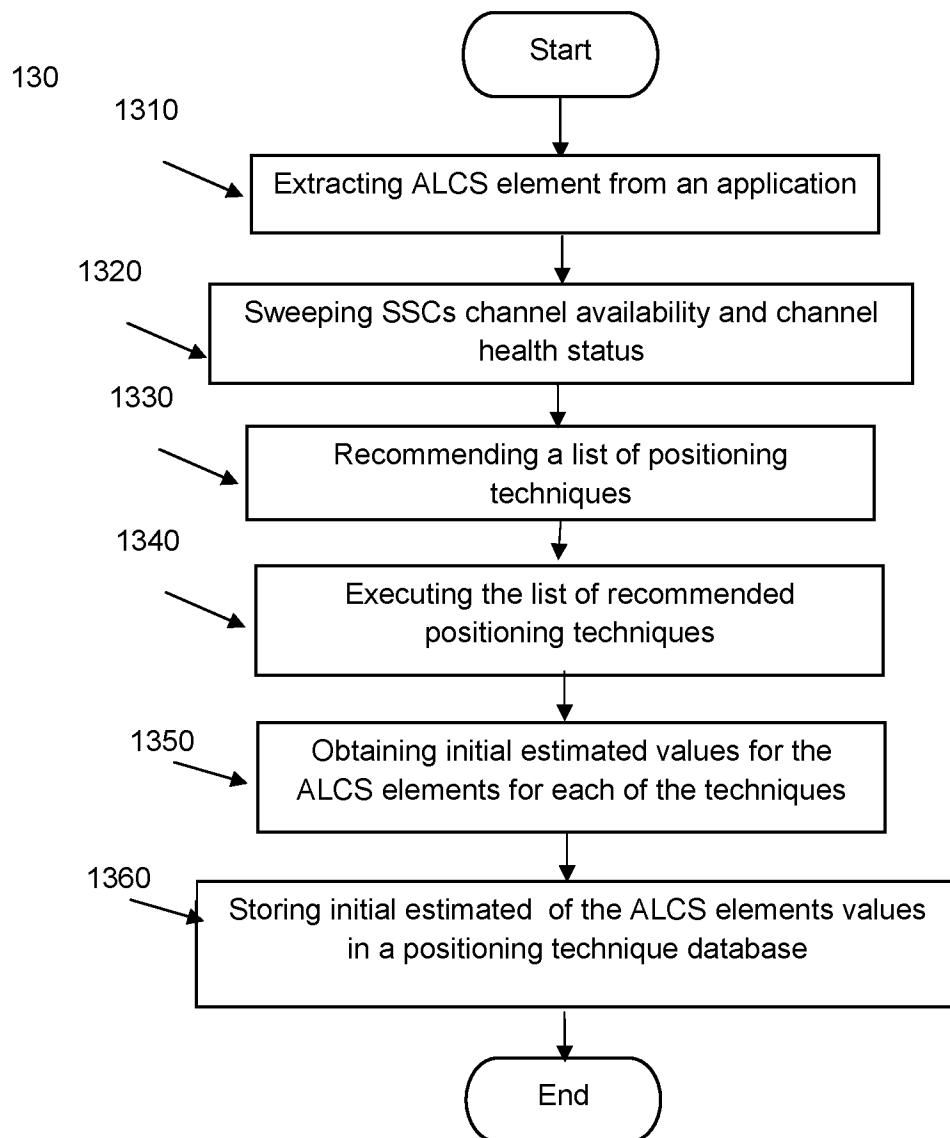


FIGURE 5

**FIGURE 6**

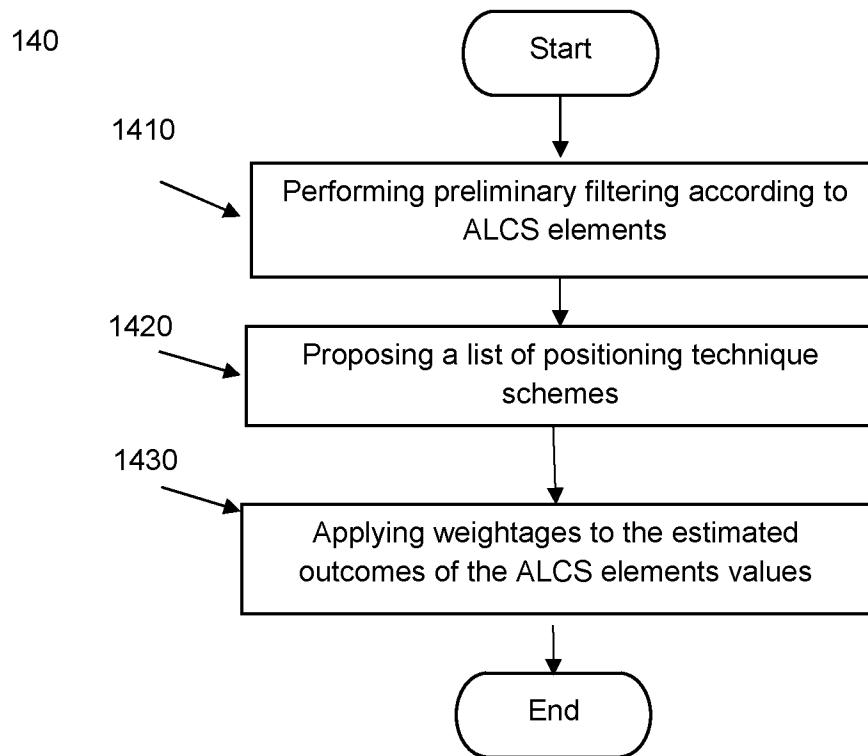


FIGURE 7

A. CLASSIFICATION OF SUBJECT MATTER**G01S 19/20(2010.01)i, G01S 19/24(2010.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01S 19/20; G01S 19/12; G01S 19/48; G01S 5/02; H04W 4/02; H04W 52/02; H04W 64/00; G01S 19/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: geospatial, positioning, estimate, channel-status, application-level

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2014-0308973 A1 (QUALCOMM INCORPORATED) 16 October 2014 Paragraphs [0005], [0116], [0131]; and figures 1-2.	1-10
A	US 2014-0274009 A1 (QUALCOMM INCORPORATED) 18 September 2014 Paragraphs [0030], [0062]; claims 1, 22; and figure 1.	1-10
A	KR 10-2013-0117800 A (SKYHOOK WIRELESS INC.) 28 October 2013 Paragraph [0042]; claim 1; and figure 4.	1-10
A	KR 10-2014-0139629 A (GOOGLE INCORPORATED) 05 December 2014 Paragraphs [0039]-[0048]; and figures 1-2.	1-10
A	US 2011-0018769 A1 (PAULI MISIKANGAS et al.) 27 January 2011 Paragraphs [0092]-[0098]; and figure 9.	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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Name and mailing address of the ISA/KR

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