Case Number: T 1726/07 - 3.4.01
Application Number: 98915132.9
Publication Number: 0978000
IPC: G01S 5/14
Language of the proceedings: EN
Title of invention:
Increased jamming immunity by optimizing processing gain for GPS/INS systems
Applicant:
RAYTHEON COMPANY
Opponent:
-
Headword:
-
Relevant legal provisions:
EPC Art. 123(2)
Relevant legal provisions (EPC 1973):
EPC Art. 84
Keyword:
"Added subject-matter (yes, all requests)"
"Lack of clarity (yes, all requests)"
Decisions cited:
-
Catchword:
-
Case Number: T 1726/07 - 3.4.01

DECISION
of the Technical Board of Appeal 3.4.01
of 29 April 2009

Appellant: RAYTHEON COMPANY
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Representative: Lawrence, John
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Composition of the Board:
Chairman: B. Schachenmann
Members: H. Wolfrum
F. Neumann
Summary of Facts and Submissions

I. European patent application 98 915 132.9 (publication No. WO 98/48295) was refused by a decision of the examining division dispatched on 11 May 2007, inter alia on the ground of added subject-matter (Article 123(2) EPC 1973) having regard to the claims of a main request and four auxiliary requests then on file.

II. The applicant lodged an appeal against the decision on 13 July 2007 and paid the prescribed fee on the same day. A statement of grounds of appeal was filed on 21 September 2007. Grant of a patent was requested on the basis of two sets of claims according to a main request and an auxiliary request.

III. On 21 November 2008 the appellant was summoned to oral proceedings to take place on 29 April 2009.

In an annex accompanying the summons pursuant to Article 15(1) RPBA the board addressed a number of deficiencies concerning added subject-matter (Article 123(2) EPC) and clarity of wording (Article 84 EPC 1973).

IV. By letter of 30 March 2009 the appellant filed new requests.

By facsimile received in the late afternoon of 28 April 2009 the appellant's representative announced that he would not be attending the oral proceedings.
V. Oral proceedings were held on 29 April 2009 in the absence of the appellant.

VI. The appellant has requested in writing that the decision under appeal be set aside and a patent be granted on the basis of amended claims 1 to 17 according to main request or on the basis of sets of claims 1 to 16 and claims 1 to 12 according to a first and a second auxiliary request, respectively, all filed together with amended pages 4 and 4a to 4c of the description with the letter of 30 March 2009.

VII. Independent claims 1 and 10 of the main request read as follows:

"1. A system for increasing jamming immunity comprising a GPS/INS system that includes:
   a processing circuit (SPC) including a signal processor which is operable to receive and down-convert GPS signals to baseband frequency to provide sine and cosine information in the form of I and Q signals;
   a residual generation circuit (I&D) which is operable to generate GPS range and range rate residuals from said I and Q signals by performing an integrate and dump operation thereon;
   a Kalman filter (KF) which filters said GPS range and range rate residuals to generate correction information by estimating navigation state corrections from said GPS range and range rate residuals;
   the system further comprising navigation means arranged to receive output of said Kalman filter and use said output to correct at least one of earth centered earth fixed (ECEF) position, velocity, initial attitude and inertial measurement unit alignment states
which are dynamically calculated from range and range rate measurements; and

dynamic line of sight means for mapping position and velocity vector information from said navigation means into geometric range and range rate scalar information and feeding said scalar information to said signal processor and to said residual generation circuit;

wherein said integrate and dump operation includes coherently adding the I signals and the Q signals separately over a predetermined time period (Ti) to provide a summation for each of the I and Q signals over the time period Ti, forming from these summations cross and dot products at the Ti rate, summing the cross and dot products over a different time interval of length Tk to provide a pair of second summations, one for the cross product signal and one for the dot product signal, and taking an arctangent function of the summed cross products and dot products and dividing the arctangent function by the integration time (Ti) to obtain said residual directly."

"10. A method for operating a GPS/INS system for increasing jamming immunity, the method comprising the steps of:

receiving and down-converting GPS signals to baseband frequency to provide sine and cosine information in the form of I and Q signals;

generating GPS range and range rate residuals from said I and Q signals by performing an integrate and dump operation thereon;

generating correction information by filtering said GPS range and range rate residuals and estimating navigation state corrections therefrom;
correcting first information using said correction information, said first information including at least one of position, velocity, attitude and alignment information; and

using second information obtained by correction of said first information to carry out at least one of said steps of receiving GPS signals and generating GPS range and range rate residuals;

wherein said correcting step includes using the output of said Kalman filter and range error and velocity error signals in a navigation function to provide guidance information and signals for correcting at least one of earth centered earth fixed (ECEF) position, velocity, initial attitude and inertial measurement unit alignment states which are dynamically calculated from range and range rate measurements;

the method further comprising the step of mapping position and velocity vector information from said navigation function into geometric range and range rate scalar information and feeding said scalar information to said signal processor and to said means to perform an integrate and dump operation;

wherein said integrate and dump operation includes coherently adding the I signals and the Q signals separately over a predetermined time period (Ti) to provide a summation for each of the I and Q signals over the time period Ti, forming from these summations cross and dot products at the Ti rate, summing the cross and dot products over a different time interval of length Tk to provide a pair of second summations, one for the cross product signal and one for the dot product signal and taking an arctangent function of the summed cross products and dot products and dividing the
arctangent function by the integration time \((Ti)\) to obtain said residual directly."

Claims 2 to 9 and 11 to 17 are dependent claims.

Claim 1 of the **first auxiliary request** differs from claim 1 of the main request in that the last feature, ie the feature which specifies the algorithm of the integrate and dump operation, is replaced by the following feature:

"wherein said residual generation circuit comprises an adder for coherently adding the I signals and the Q signals separately over a predetermined time period \((Ti)\) to provide a summation for each of the I and Q signals over the time period \(Ti\) for each of an early channel and a late channel, squaring circuitry for squaring the received I and Q signals in each of the early channel and late channel to provide an envelope detect, a summer for summing the squared signals separately in each of the early channel and late channel for the time period \(Ti\), an envelope detection circuit providing envelope detection for each channel prior to computation of the range residual, said envelope detection being circuitry to provide the difference between the early channel and late channel divided by the sum of the early channel and late channel."

Independent method claim 9 of the first auxiliary request is identical to claim 10 of the main request and claims 2 to 8 and 10 to 16 are dependent claims.

Independent claims 1 and 7 of the **second auxiliary request** are identical to claims 1 and 10 of the main
request, respectively, and claims 2 to 6 and 8 to 12 are dependent claims.

**Reasons for the Decision**

1. In the light of the entry into force of the EPC 2000, reference is made to Article 7(1), 2nd sentence of the Revision Act of 29 November 2000 ("Act revising the Convention on the Grant of European Patents (European Patent Convention) of 5 October 1973, last revised on 17 December 1991") and the transitional provisions for the amended and new provisions of the EPC (Decision of the Administrative Council of 28 June 2001), from which it may be derived which Articles of the EPC 1973 are still applicable and which Articles of the EPC 2000 shall apply.

2. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC 1973 and is, therefore, admissible.

3. Amendments

Claim 1 of the main request as well as of the first and second auxiliary requests refers to "a residual generation circuit (I&D) which is operable to generate GPS range and range rate residuals from said I and Q signals by performing an integrate and dump operation thereon". A line of sight means for mapping position and velocity vector information into geometric range and range rate scalar information feeds said scalar information to the residual generation circuit.
The term "residual generation circuit" is not used in the application documents as originally filed, which refer instead to "means to perform an integrate and dump operation on said I and Q signals to provide GPS range and range rate residuals which are uncorrelated from sample to sample" and to which is fed the aforementioned scalar information from the line of sight means (see for instance claim 1 as originally filed).

The Board notes that neither the residual generation circuit defined in current claim 1 nor the means to perform an integrate and dump operation as defined in original claim 1 are consistent with the conventional understanding of the roles and functions of the various subunits of a GPS system, according to which a generation of residuals and an integrate and dump operation are different types of operations (see point 4 below). However, even if, in some unfathomable way, an integrate and dump means as originally claimed should additionally manage to generate residuals or a residual generation circuit as currently claimed should be able to calculate residuals by means of performing an integrate and dump operation, this does not change the fact that for a skilled person with conventional wisdom the generation of residuals and the execution of an integrate and dump operation, if implemented by hardware, both require different circuitry. According to claim 1 of all current requests, scalar information from the line of sight means is fed to a residual generation circuit. There is no disclosure in the application documents as originally filed of such subject-matter. In particular, the scalar information was originally disclosed as being fed to means which
perform an integrate and dump operation. Consequently, the requests on file introduce subject-matter which extends beyond the content of the application as originally filed.

4. Clarity (Article 84 EPC 1973)

4.1 According to conventional wisdom in the field of GPS technology, an integrate and dump operation is employed to smooth the received I and Q signals so as to reduce noise and interference. This operation is quite distinct from the generation of GPS range and range rate residuals which are calculated during the initial phase of satellite signal acquisition for the purpose of tracking and locking the code phase as well as the carrier phase and frequency of a received satellite signal by determining the deviations between the received code signal and an internal replica code signal that is modified based on the most recent estimates of phase and frequency. The generation of said residuals is an iterative process resulting in a stepwise improvement of said estimates until the residuals become zero.

Therefore, it is not conceivable that a residual generation circuit could generate such residuals merely by performing an integrate and dump operation on the received I and Q signals, as specified in claim 1 of each of the three requests on file.

Likewise, it is not imaginable that an integrate and dump operation, which is a mere smoothing operation, would include the execution of an algorithm as specified in the final feature of claim 1 of the main
request and of the second auxiliary request and could thus produce a residual in the generally recognized meaning of this term.

As an aside it is noted that the claim definitions under consideration are unclear in themselves and not supported by the description because the residual generation circuit is required to generate GPS range residuals as well as GPS range rate residuals whereas the specific algorithm which is defined in the final feature of claim 1 of the respective requests on file produces only one type of residual. In fact, as is apparent from the description (see in particular page 14, line 13 to page 16, line 11, of the published application), the algorithm defined in claim 1 of the main request and the second auxiliary request produces only a GPS range rate residual, whereas the algorithm defined in claim 1 of the first auxiliary request produces a GPS range residual.

4.2 A further ambiguity, which is common to claim 1 of all requests on file, concerns the role and manner of use of the scalar information from the line-of-sight means for the structure and operation of the residual generation circuit to which said information is fed. In fact, it remains unclear from the claims - and there is no supporting explanation given in the remainder of the application documents - as to how exactly the scalar information is fed into the residual generation circuit and how the residual generation circuit actually uses said scalar information in the generation of a residual, particularly when executing the respectively claimed algorithm. Neither the algorithm for the integrate and dump block of Figure 1 as shown
in Figure 2 nor the alternative algorithm as shown in Figure 3 makes use of such scalar information.

5. The appellant's arguments and explanations given in writing do not address the aforementioned objections.

Thus, for the reasons set out in points 3 and 4 above, the board has come to the conclusion that the appellant's requests do not comply with the requirements of Article 123(2) EPC and Article 84 EPC 1973.

The appellant's requests are therefore not allowable.

Order

For these reasons it is decided that :

The appeal is dismissed.

The Registrar The Chairman

R. Schumacher B. Schachenmann