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Datasheet for the decision
of 29 April 2009

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:
—

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Beschwerdekammern   Boards of Appeal   Chambres de recours

Case Number: T 1726/07 **-** 3.4.01

D E C I S I O N
of the Technical Board of Appeal 3.4.01
of 29 April 2009

Appellant: RAYTHEON COMPANY
                                  2501 South Highway 121
                                  Lewisville, TX 75067   (US)

Representative: Lawrence, John
                                  Barker Brettell LLP
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Decision under appeal: **Decision of the Examining Division of the**
                                  European Patent Office posted 11 May 2007
                                  refusing European application No. 98915132.9
                                  pursuant to Article 97(1) EPC 1973.

Composition of the Board:

Chairman: B. Schachenmann
Members: H. Wolfrum
                   F. Neumann

C1068.D

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

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

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