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D E C I S I O N
of 3 March 2005

Case Number: T 1259/01 - 3.5.3

Application Number: 97953047.4

Publication Number: 0948750

IPC: G01S 5/02

Language of the proceedings: EN

Title of invention:
Attitude determination method and system

Applicant:
HONEYWELL INC.

Opponent:
-

Headword:
Attitude Determination/HONEYWELL

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
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Case Number: T 1259/01 - 3.5.3

D E C I S I O N
of the Technical Board of Appeal 3.5.3
of 3 March 2005

Appellant: HONEYWELL INC.
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Representative: Fox-Male, Nicholas VH
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 20 July 2001 refusing European application No. 97953047.4 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. S. Clelland
Members: A. Ritzka
M. B. Tardo-Dino

Summary of Facts and Submissions

I. This is an appeal from the decision of the Examining Division to refuse European Patent application No. 97 953 047.4, originally filed as international application PCT/US97/21500, with publication No. WO 98/29757. The decision was dispatched on 20 July 2001. The reason given for refusing the application was that the claimed subject-matter lacked novelty in the light of document D1: US-A-4754280A.

II. Notice of appeal was filed and the fee paid on 19 September 2001. The statement setting out the grounds for the appeal was filed on 20 November 2001.

III. The board issued an invitation to oral proceedings accompanied by a communication. In the communication the board gave its preliminary view that the subject-matter of claim 1 in the version discussed during oral proceedings before the first instance on 3 July 2001 lacked novelty and an inventive step in view of D1. Furthermore the board gave its opinion on the grounds for the appeal.

IV. In a letter dated 3 February 2005 in response to the communication a new main request and three auxiliary requests were submitted. As main request the maintenance of the existing claims was requested. The board interprets this as a request to grant a patent on the basis of claims 1 to 32 filed with the letter dated 1 June 2001. Three sets of amended claims were filed by way of the three auxiliary requests.

Independent claim 1 according to the main request reads as follows:

"A method for use in vehicle attitude determination using one or more inertial measurements and GPS signals from two or more space vehicles, the method characterised by the steps of:

providing an inertial navigation system (101, 201, 301, 401) including a filter (118, 218, 318, 418) for receiving at least one or more inertial measurements (115-16, 215-16, 315-16, 415-16) for use in generating a vehicle attitude estimate (120, 220, 320, 420);

generating GPS attitude solutions (113, 213, 313, 413) for a vehicle, which solutions are independent of the inertial measurements, using three or more antennas (39) receiving GPS signals from two or more space vehicles;

providing the GPS attitude solutions to the filter; and

initializing the inertial navigation system by setting the vehicle attitude estimate of the inertial navigation system to one of the GPS attitude solutions generated for the vehicle."

Claim 17 is an independent claim directed to a system for use in vehicle attitude determination using one or more inertial measurements and GPS signals from two or more space vehicles, the system being characterised by features corresponding to the method steps of claim 1.

Claim 1 according to the first auxiliary request differs from claim 1 of the main request in that, in the step of generating GPS attitude solutions, the solutions comprise absolute whole value attitude and

the inertial navigation system is initialised by setting the vehicle attitude estimate of the inertial navigation system to an absolute whole value attitude.

Claim 17 is an independent system claim corresponding to claim 1.

Claim 1 according to the second auxiliary request adds to claim 1 of the main request the feature that the vehicle attitude estimate (120, etc) of the inertial navigation system (101, etc) is updated using the GPS attitude solutions generated for the vehicle independent of the inertial measurements.

Claim 16 is an independent system claim corresponding to claim 1.

Claim 1 according to the third auxiliary request adds to claim 1 of the main request the feature that the initialisation and alignment steps are performed when the vehicle is in motion.

Claim 16 is an independent system claim corresponding to claim 1.

At the oral proceedings held on 3 March 2005 the appellant maintained the main request and the auxiliary requests submitted with the letter dated 3 February 2005 (see paragraph IV). At the end of the oral proceedings the board's decision was announced.

Reasons for the Decision

1. *Technical background*

Satellite navigation receivers are capable of extremely high attitude accuracy utilising interferometric techniques. However, in conditions of rapid vehicle manoeuvring, the interferometric data changes too rapidly to be tracked by such navigation receivers and therefore attitude information is temporarily lost until the receiver can re-stabilise itself.

Inertial measurement units are capable of accurately following vehicle manoeuvring at substantial rates. Inertial sensors of such inertial measurement units however are subject to drift, which in the long run contributes significant inaccuracies to the measured attitude.

D1 discloses a system for sensing the attitude of a vehicle that relies on the advantages of both the inertial navigation system and the satellite navigation system. The system suggested by D1 is initialised by data received from the navigation satellites indicating their position as well as an estimate of the position and attitude of the sensing system (see column 2, lines 10 to 13). The attitude information represented by the output of an inertial measurement unit is used to provide a vehicle attitude signal which is corrected by means of a digital filter according to the attitude information gathered from the satellite receiver system (see column 4, lines 3 to 8). Furthermore D1 makes use of GPS satellites (see Figure 3, "GPS SATELLITE") and discloses that using known interferometric detection

techniques (see Figures 1 and 3, antennas 32, 34, 36) the attitude of a vehicle relative to a satellite of the satellite navigation system can be completely resolved free of all ambiguities and, from positional data on the satellite transmitted by it, can be converted to an attitude of the vehicle relative to the earth (see Figures 1 and 3, and column 3, lines 37 to 47). According to the preferred embodiment described in D1 the system is initialised using estimates of attitude. These estimates can be provided by any convenient means (see column 8, lines 49 to 56).

2. *Novelty (all requests)*

The subject-matter of claim 1 of all requests differs from the disclosure of D1 in providing two additional technical features:

Generating GPS attitude solutions for a vehicle, as opposed to attitude signals, which solutions are independent of inertial measurements; and

initialising the inertial navigation system by setting the vehicle attitude estimate of the inertial navigation system to one of the GPS attitude solutions generated for the vehicle.

The subject-matter of claim 1 of all the requests is accordingly novel.

The same applies, mutatis mutandis, to the corresponding system claim of all requests.

3. *Inventive step*

3.1 Main request

As noted at point 1 above, D1 states that any convenient means can be used in providing estimates of attitude for initialisation. In the board's view this also includes the attitude solutions derived from the satellite data as disclosed in D1, column 3, lines 37 to 47. These attitude solutions are independent of inertial measurements, so that the skilled person, starting out from the teaching of D1 and initialising the inertial navigation system by setting the vehicle attitude estimate of the inertial navigation system to one of the GPS attitude solutions generated for the vehicle, would arrive at the claimed method. Accordingly, the subject-matter of claim 1 does not in the board's view involve an inventive step.

The arguments raised by the appellant in favour of inventive step are not considered by the board to be persuasive. The appellant states as one benefit that the subject-matter according to claim 1 can be realised using simpler measurement equations and reduced measurement processing compared to D1; according to D1 an analog signal processing including a set of adjustable phase loops providing differential phases is used whereas according to the subject-matter of claim 1 GPS solutions generated independently from the GPS signals are used. However these GPS signals are also received and submitted to a signal processing which at least partially is analog. It was also argued that the invention provided a more effective initialisation because the initialisation could take place even if the

vehicle was being transported on another vehicle e.g. a missile on a rolling train. In the course of the oral proceedings the appellant was unable to show that the system according to D1 did not permit initialisation on a moving vehicle. The board takes the view that D1 does not exclude such initialisation.

The appellant also argued that more weight should be attributed to the information given in the context of the preferred embodiment than in the summary of the invention of D1; since according to the preferred embodiment the system had been initialised using information developed in the inertial measurement unit, the skilled person would put no weight on the statement in the summary of the invention that the system was initialised by data received from the navigation satellites, indicating their position, as well as an estimate of the position and attitude of the sensing system. However, the board observes that the disclosure of a document has to be taken as a whole and cannot be limited to a preferred embodiment.

Since the subject-matter of independent claim 17 corresponds *mutatis mutandis* to the subject-matter of claim 1, the same argumentation applies to claim 17.

In consequence the independent claims of the main request do not satisfy the requirements of Articles 52 and 56 EPC.

3.2 First auxiliary request

In the course of the oral proceedings the appellant stated that the independent claims of the first

auxiliary request differed from the independent claims of the main request only in clarifying amendments which did not contain any further technical limitations and did not alter the scope of the claims. The reference to "absolute whole value attitude" was intended to make clear that the claimed attitude solutions were generated completely independently of inertial measurements. As noted at point 3.1 above, the passage at column 3, lines 37 to 47 of D1 points the skilled person in the direction of using an independent estimate of attitude, such as one derived from the satellite data, for initialisation. Consequently the arguments above on the main request apply equally to the first auxiliary request. Hence the independent claims of the first auxiliary request do not satisfy the requirements of Articles 52 and 56 EPC.

3.3 Second auxiliary request

The independent claims according to the second auxiliary request contain the additional limitation that the inertial navigation system attitude estimate is updated using the GPS attitude solutions generated independently of the inertial measurements. In the system according to the preferred embodiment of D1, see column 2, lines 1 to 4 and column 4, lines 34 to 37, the estimates are periodically updated, e.g. every 10 seconds, to reflect satellite information and otherwise follow the inertial outputs. The passage at D1, column 4, lines 34 to 37 points the skilled person in the direction of using the estimates used for initialisation also for updating these estimates. Using the GPS attitude solutions generated for the vehicle independent of the inertial measurements for updating

the vehicle attitude estimate of the inertial navigation system therefore does not involve an inventive step.

The independent claims of the second auxiliary request consequently do not satisfy the requirements of Articles 52 and 56 EPC.

3.4 Third auxiliary request

3.4.1 The independent claims according to the third auxiliary request contain the additional limitation that initialisation and alignment steps are performed when a vehicle is in motion. This feature is discussed at page 21, lines 20 to 22 of the description. Hence the third auxiliary request satisfies the requirements of Article 123(2) EPC.

3.4.2 It is not clear to the board what technical features are implied by the fact that initialisation and alignment steps are performed when a vehicle is in motion. In particular, limitation of the claims to a specific use does not appear to alter the method or the system of attitude determination. The board accordingly concludes that claim 1 and 16 of this request do not comply with Article 84 EPC as to clarity.

3.4.3 Moreover, insofar as the independent claims can be understood, use of the claimed method and system in a moving vehicle cannot contribute to inventive step, given that inertial navigation is intended for use in moving vehicles, see D1 at column 1, lines 17 to 35. The independent claims according to the third auxiliary request therefore do not involve an inventive step.

Hence the independent claims of the third auxiliary request do not satisfy the requirements of Articles 52, 56 and 84 EPC.

4. There being no other requests, it follows that the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Magliano A. S. Clelland