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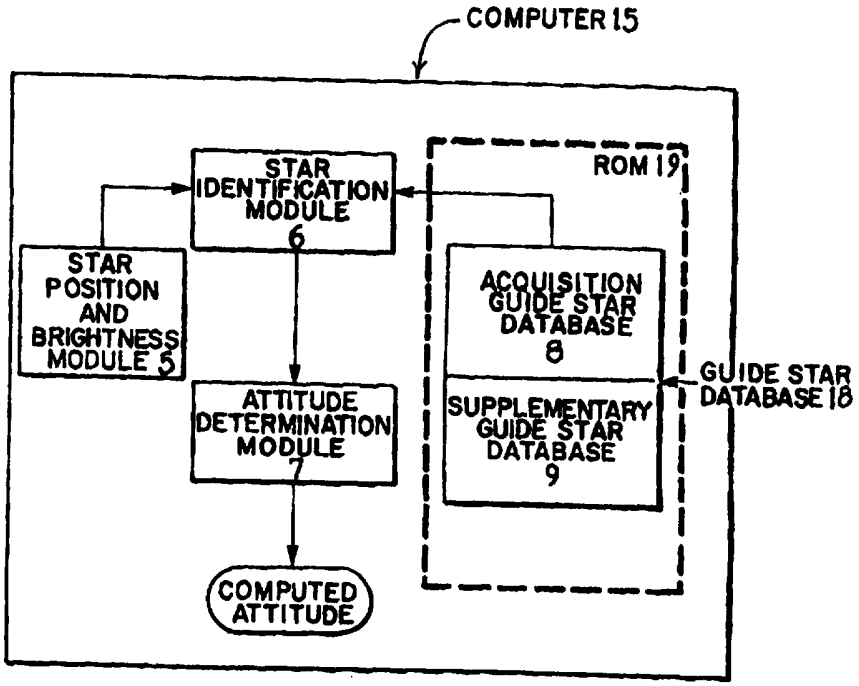
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12 September 1997 (12.09.97)

(54) Title: TECHNIQUES FOR OPTIMIZING AN AUTONOMOUS STAR TRACKER

(57) Abstract

A method for determining the attitude of a spacecraft (1) by observing stars (2) within a starfield (3). A detector (13), camera electronics (14), and computer (15) located on board the spacecraft (1) are used to generate a set of star match groups by matching pairs of stars observed by the detector (13) with pairs of guide stars from a stored database (18) of guide stars. Match groups having small numbers of stars are eliminated. Non-eliminated match groups are validated. Redundant match groups are eliminated. A match group having the largest number of stars is selected. Finally, the attitude of the spacecraft (1) is derived from positions of guide stars within the selected match group. The guide star database (18) can be broken into an acquisition guide star database (8) and a supplementary guide star database (9). The field of view (20) of detector (13) can be broken into a grid of pixels overlaid by a grid of superpixels (21). The guide star pairs are preferably presorted in order of increasing angular separation. An identification matrix (IDGRP) can be used to speed the star identification process.



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INTERNATIONAL SEARCH REPORT

rnational Application No
PCT/US 96/15425

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B64G1/36

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)
IPC 6 B64G G01C G01S

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 658 361 A (KOSAKA ET AL.) 14 April 1987 see column 1, line 36 - line 63 see column 2, line 23 - column 6, line 21; figures 1-9 ---	1
Y	SPIE'S INTERNATIONAL SYMPOSIUM ON OPTICAL ENGINEERING IN AEROSPACE SENSING, 5 April 1994, ORLANDO, FLORIDA, USA, pages 1-13, XP000645853 VAN BEZOOIJEN, R.W.H.: "TRUE-SKY DEMONSTRATION OF AN AUTONOMOUS STAR TRACKER" cited in the application see the whole document --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

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"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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Date of the actual completion of the international search	Date of mailing of the international search report
19 March 1997	25. 07. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	RIVERO C.G.

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INTERNATIONAL SEARCH REPORT

national Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 03215 A (HONEYWELL INC.) 2 February 1995 see page 1, line 18 - page 3, line 8 see page 4, line 8 - page 12, line 27; figures 1-7 ---	1
A	US 4 617 634 A (IZUMIDA ET AL.) 14 October 1986 see column 3, line 4 - column 11, line 53; figures 1-12 -----	1

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 96/ 15425

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claim 1
Claims 2-3
Claims 4-6
Claims 7-12

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

mational Application No
PCT/US 96/15425

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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