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(54) Title: POINT CLOUD FILTER METHOD AND APPARATUS

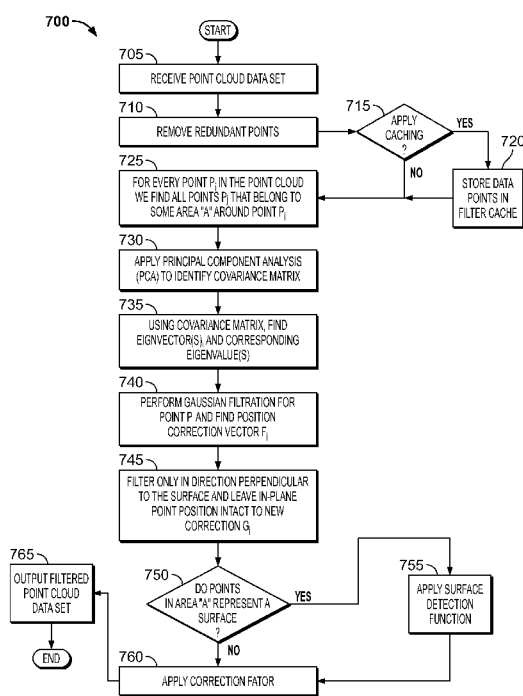


FIG. 7

(57) Abstract: A point cloud filter method and apparatus is provided for use in point cloud rendering from real-time point cloud data collection from a variety of sensor types is provided that delivers enhanced performance including reducing processing requirements, limiting local memory consumption and optimizing overall data visualization.



Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/041183

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06T17/00
ADD.
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)
G06T

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 practicable, search terms used)
EPO-Internal, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>VALDIVIA PAOLA ET AL: "Normal Correction towards Smoothing Point-Based Surfaces", PROCEEDINGS - BRAZILIAN SYMPOSIUM ON COMPUTER GRAPHICS AND IMAGEPROCESSING, IEEE COMPUTER SOCIETY, LOS ALAMITOS, CA, US, 5 August 2013 (2013-08-05), pages 187-194, XP032524052, ISSN: 1530-1834, DOI: 10.1109/SIBGRAPI.2013.34 [retrieved on 2013-11-05] abstract; p.188, right col., last three pars. p.188, right col., last par - p.189, par.1-2 p.190, section "C. Surface Smoothing", fig.1-2</p> <p style="text-align: center;">----- -/--</p>	<p>1-7, 11-17, 19,20</p>

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "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

Date of the actual completion of the international search

29 October 2018

Date of mailing of the international search report

09/01/2019

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/041183

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

see additional sheet

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 fees, this Authority did not invite payment of additional fees.
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.:

1-7, 11-17, 19, 20

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7, 11-17, 19, 20

The first subject matter (claims 1-7, 11-17, 19-20)
The first subject matter is related to a method etc. as
summerized above and as claimed by claim 1; its special
technical features can be summerized as follows:

-
position correction vector F_i is defined by a weighted
sum from the points in the area \bar{A} , the weights determined by
an exponential function.
(from claims 5, 15) .

2. claims: 8, 18

The second subject matter is related to a method etc. as
summerized above and as claimed by claim 1; its special
technical features can be summerized as follows:

-
the three-dimensional point cloud is generated in real-time
using at least one compacted prefix tree . (from claims 8,
18)

3. claims: 9, 10

The third subject matter is related to a method etc. as
summerized above and as claimed by claim 1; its special
technical features can be summerized as follows:

-
separating the individual points P_i of the point cloud data
set into three principal component grids ; and
using the at last three principal component grids to process
the individual points P_i of the point cloud data set in
batches from the filter cache.
(from claims 9) .

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/041183

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>LEAL NARVAEZ E A ET AL: "Point cloud denoising using robust principal component analysis", GRAPP 2006. FIRST INTERNATIONAL CONFERENCE ON COMPUTER GRAPHICS THEORY AND APPLICATIONS. PROCEEDINGS INSTITUTE FOR SYSTEMS AND TECHNOLOGIES OF INFORMATION, CONTROL AND COMMUNICATION PORTUGAL, 2006, page 8 pp., XP002786117, ISBN: 972-8865-39-2 abstract; p.3, left col., eq.2 -----</p>	<p>1-7, 11-17, 19,20</p>
A	<p>ALEXA M ET AL: "Point set surfaces", VISUALIZATION, 2001. VIS '01. PROCEEDINGS, IEEE, PI, 1 January 2001 (2001-01-01), pages 21-537, XP031172865, DOI: 10.1109/VISUAL.2001.964489 ISBN: 978-0-7803-7201-6 p.2, left col., upper half -----</p>	<p>1-7, 11-17, 19,20</p>