(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 312 534 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
06.07.2011 Bulletin 2011/27

(43) Date of publication A2:
20.04.2011 Bulletin 2011/16

(21) Application number: **10013335.4**

(22) Date of filing: **05.10.2010**

(51) Int Cl.:
G06T 19/00 *(2011.01)* *G06T 15/08* *(2011.01)*
G06T 15/30 *(2011.01)* *A61B 8/13* *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **15.10.2009 JP 2009238767**
15.10.2009 JP 2009238768

(71) Applicant: **Hitachi Aloka Medical, Ltd.**
Mitaka-shi
Tokyo,
181-8622 (JP)

(72) Inventors:
- **Seko, Koji**
  Oume-shi
  Tokyo 198-8577 (JP)
- **Nagase, Yuko**
  Oume-shi
  Tokyo 198-8577 (JP)
- **Narita, Hirohiko**
  Oume-shi
  Tokyo 198-8577 (JP)
- **Yokoi, Atsuko**
  Oume-shi
  Tokyo 198-8577 (JP)

(74) Representative: **Heim, Florian Andreas et al**
Weber & Heim
Patentanwälte
Irmgardstraße 3
81479 München (DE)

(54) Ultrasonic volume data processing device

(57) An ultrasonic volume data processing device which forms a three-dimensional image of a target tissue in a living body is provided. A range in which a rendering process is applied is limited by a three-dimensional region of interest (3D-ROI). The three-dimensional region of interest has a clipping plane as a rendering start surface. A shape of the clipping plane can be deformed into a convex shape or a concave shape by a user operation, and the clipping plane may be freely inclined in two-dimensional directions. With this configuration, for example, the clipping plane can be suitably positioned in a gap between a face of a fetus and a placenta. When the curved clipping plane is used, a striped pattern noise tends to be formed in the three-dimensional image. In order to resolve or reduce the striped pattern noise, a special voxel calculation is applied to a final voxel of each ray in the voxel calculation for each ray.

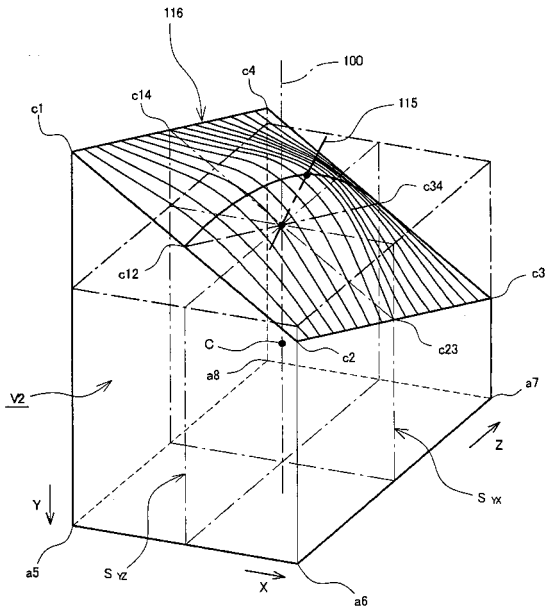

FIG. 8

EP 2 312 534 A3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 01 3335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	JP 2004 033658 A (MATSUSHITA ELECTRIC IND CO LTD) 5 February 2004 (2004-02-05) * the whole document * -----	1-13	INV. G06T19/00 ADD.
X,D	US 2006/058605 A1 (DEISCHINGER HARALD [AT] ET AL) 16 March 2006 (2006-03-16) * figures 4,5,6A,6B,6C, 8 * * paragraph [0002] - paragraph [0003] * * paragraph [0005] - paragraph [0006] * * paragraph [0022] - paragraph [0024] * * paragraph [0026] - paragraph [0027] * -----	1-13	G06T15/08 G06T15/30 A61B8/13
X	US 5 734 384 A (YANOF JEFFREY H [US] ET AL) 31 March 1998 (1998-03-31) * figures 6A-6H * * column 2, line 44 - line 59 * * column 3, line 17 - line 25 * * column 3, line 33 - line 40 * * column 3, line 50 - line 54 * * column 4, line 13 - line 22 * * column 4, line 58 - line 62 * * column 5, line 41 - line 44 * * column 7, line 13 - line 43 * * column 8, line 18 - line 25 * * column 8, line 49 - line 57 * * column 9, line 44 - column 10, line 14 * * column 12, line 1 - line 30 * * column 13, line 5 - line 32 * * column 13, line 53 - column 15, line 17 * -----	1-13	TECHNICAL FIELDS SEARCHED (IPC) G06T A61B
A,D	JP 2004 113603 A (HITACHI MEDICAL CORP) 15 April 2004 (2004-04-15) * the whole document * -----	1-13	
A,D	JP 2001 145631 A (ALOKA CO LTD) 29 May 2001 (2001-05-29) * the whole document * -----	1-13	
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	30 May 2011	Gauthier, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 01 3335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2006 167100 A (TOSHIBA CORP; TOSHIBA MEDICAL SYS CORP) 29 June 2006 (2006-06-29) * the whole document * -----	1-13	
A	WEILER M ET AL: "Direct volume rendering in OpenSG", COMPUTERS AND GRAPHICS, ELSEVIER, GB, vol. 28, no. 1, 1 February 2004 (2004-02-01), pages 93-98, XP004484898, ISSN: 0097-8493, DOI: DOI:10.1016/J.CAG.2003.10.009 * page 93, left-hand column, line 1, paragraph 1. - line 7 * * page 97, left-hand column, line 1, paragraph 7. - last line; figure 5 * -----	1-13	
X	ROETTGER S ET AL: "SMART HARDWARE-ACCELERATED VOLUME RENDERING", PROCEEDINGS OF THE JOINT EUROGRAPHICS AND IEEE TCVG SYMPOSIUM ONVISUALIZATION, DATA VISUALIZATION, XX, XX, 1 January 2003 (2003-01-01), pages 231-301, XP008059777, Y * page 231, right-hand column, line 22 - last line * * page 232, left-hand column, line 22 - page 233, left-hand column, line 22 * * page 233, right-hand column, line 6, paragraph 3 - line 12 * * page 234, left-hand column, line 32 - line 45 * * figures 1,3,4,5 * -----	16-21 14,15	TECHNICAL FIELDS SEARCHED (IPC)
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	30 May 2011	Gauthier, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 01 3335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KEREM KARADAYI ET AL: "Three-Dimensional Ultrasound: From Acquisition to Visualization and From Algorithms to Systems", IEEE REVIEWS IN BIOMEDICAL ENGINEERING, IEEE, USA, vol. 2, 1 January 2009 (2009-01-01), pages 23-39, XP011284052, ISSN: 1937-3333	16,20	
Y	* page 28, right-hand column, line 1, paragraph III.B - page 31, right-hand column, last line, paragraph III.B.2; figures 4,7,8,9 *	14,15	
	----- -/--		
			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	30 May 2011	Gauthier, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 01 3335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	ROBERT B ET AL: "An interactive tool to visualize three-dimensional ultrasound data", ULTRASOUND IN MEDICINE AND BIOLOGY, NEW YORK, NY, US, vol. 26, no. 1, 1 January 2000 (2000-01-01), pages 133-142, XP004295498, ISSN: 0301-5629, DOI: DOI:10.1016/S0301-5629(99)00111-8 * page 135, left-hand column, line 14 - right-hand column, line 24 * * figure 1 * * page 137, left-hand column, line 24 - right-hand column, line 12 * * figure 3 * * page 138, left-hand column, line 1 - right-hand column, line 6 * * page 140, left-hand column, line 35 - left-hand column, line 41 * * page 140, right-hand column, line 2 - line 9 * * page 140, right-hand column, line 34 - line 38 * * page 140, right-hand column, line 43 - page 141, left-hand column, line 3 * -----	1-22	
A,D	JP 2000 339486 A (NEC CORP) 8 December 2000 (2000-12-08) * the whole document * -----	14-22	
			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	30 May 2011	Gauthier, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number
EP 10 01 3335

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

Europäisches Patentamt
European Patent Office
Office européen des brevets

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 10 01 3335

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-13

   3D positionning and adjustment of ROI Convex Clipping plane in 3D US data visualization

   ---

2. claims: 14-22

   Anti-moiré method for the raytrace-based rendering of 3D US data

   ---

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 01 3335

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-05-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2004033658 A	05-02-2004	JP 3928506 B2	13-06-2007
US 2006058605 A1	16-03-2006	FR 2874715 A1	03-03-2006
		JP 2006061698 A	09-03-2006
US 5734384 A	31-03-1998	NONE	
JP 2004113603 A	15-04-2004	JP 4096170 B2	04-06-2008
JP 2001145631 A	29-05-2001	NONE	
JP 2006167100 A	29-06-2006	JP 4619766 B2	26-01-2011
JP 2000339486 A	08-12-2000	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	超声波体积数据处理装置		
公开(公告)号	EP2312534A3	公开(公告)日	2011-07-06
申请号	EP2010013335	申请日	2010-10-05
[标]申请(专利权)人(译)	日立阿洛卡医疗株式会社		
申请(专利权)人(译)	ALOKA CO.，LTD.		
当前申请(专利权)人(译)	日立ALOKA MEDICAL.，LTD.		
[标]发明人	SEKO KOJI NAGASE YUKO NARITA HIROHIKO YOKOI ATSUKO		
发明人	SEKO, KOJI NAGASE, YUKO NARITA, HIROHIKO YOKOI, ATSUKO		
IPC分类号	G06T19/00 G06T15/08 G06T15/30 A61B8/13		
CPC分类号	G06T19/00 A61B8/14 A61B8/463 G06T15/08 G06T2207/10136 G06T2207/30044 G06T2210/41 G06T2219/008		
优先权	2009238768 2009-10-15 JP 2009238767 2009-10-15 JP		
其他公开文献	EP2312534A2		
外部链接	Espacenet		

摘要(译)

提供一种超声体积数据处理装置，其形成活体中的目标组织的三维图像。应用渲染处理的范围受到三维感兴趣区域（3D-ROI）的限制。三维感兴趣区域具有剪切平面作为渲染起始表面。通过用户操作，剪切平面的形状可以变形为凸形或凹形，并且剪切平面可以在二维方向上自由倾斜。利用这种配置，例如，剪取平面可以适当地定位在胎儿的面部和胎盘之间的间隙中。当使用弯曲的剪切平面时，趋向于在三维图像中形成条纹图案噪声。为了解决或减少条纹图案噪声，在每个光线的体素计算中将特殊体素计算应用于每条光线的最终体素。

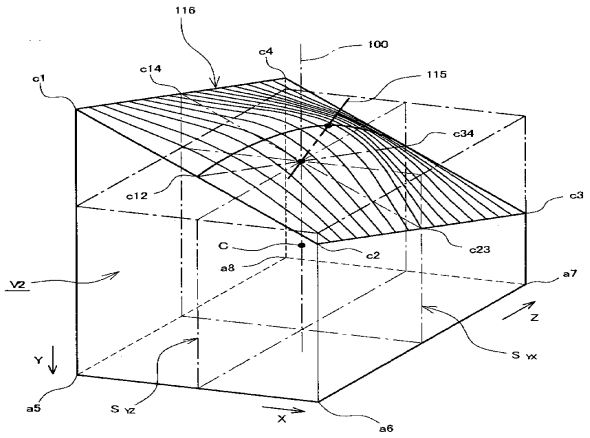

FIG. 8