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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
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CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD,
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) Title: CONTRAST ENHANCED MAGNETIC RESONANCE ANGIOGRAPHY WITH CHEMICAL SHIFT ENCODING
FOR FAT SUPPRESSION

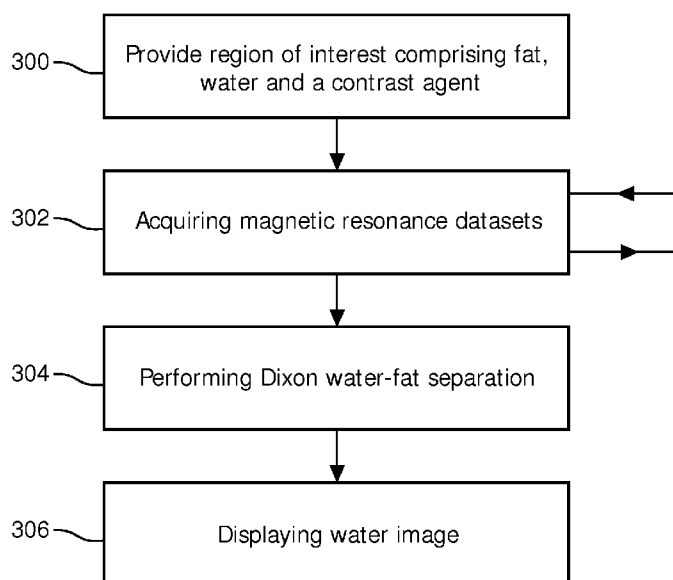


FIG. 3

(57) Abstract: The invention relates to a method of performing contrast enhanced first pass magnetic resonance angiography, the method comprising: acquiring (302) magnetic resonance datasets of a region of interest using a single- or multi-echo data acquisition technique, wherein the echo times of the one or multiple echoes are flexible, wherein at the time of the data acquisition the region of interest comprises fat, water and a contrast agent, processing (304) the datasets using a generalized Dixon water-fat separation technique to eliminate the signal originating from the fat from the background for reconstruction of an image data set.



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

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28 February 2013

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/051902

A. CLASSIFICATION OF SUBJECT MATTER INV. G01R33/54 G01R33/561 G01R33/56 G01R33/563 G01N24/08 G01R33/48 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) G01R G01N 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, WPI Data											
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; padding: 5px;">Category*</th> <th style="width: 70%; padding: 5px;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width: 20%; padding: 5px;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;"> JINGFEI MA: "A Single-Point Dixon Technique for Fat-Suppressed Fast 3D Gradient-Echo Imaging With a Flexible Echo Time", JOURNAL OF MAGNETIC RESONANCE IMAGING, 2008 WILEY-LISS, INC, vol. 27, no. 4, 26 February 2008 (2008-02-26), pages 881-890, XP007919289, DOI: DOI 10.1002/JMRI.21281 page 881 - page 886; figures 2,6 page 888, column 2 - page 889, column 2 ----- </td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,2,6,7</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;"> WO 2010/113048 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; PHILIPS INTELLECTUAL PROPERTY [DE]) 7 October 2010 (2010-10-07) cited in the application the whole document ----- -/- </td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,2,6,7</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	JINGFEI MA: "A Single-Point Dixon Technique for Fat-Suppressed Fast 3D Gradient-Echo Imaging With a Flexible Echo Time", JOURNAL OF MAGNETIC RESONANCE IMAGING, 2008 WILEY-LISS, INC, vol. 27, no. 4, 26 February 2008 (2008-02-26), pages 881-890, XP007919289, DOI: DOI 10.1002/JMRI.21281 page 881 - page 886; figures 2,6 page 888, column 2 - page 889, column 2 -----	1,2,6,7	A	WO 2010/113048 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; PHILIPS INTELLECTUAL PROPERTY [DE]) 7 October 2010 (2010-10-07) cited in the application the whole document ----- -/-	1,2,6,7
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A	WO 2010/113048 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; PHILIPS INTELLECTUAL PROPERTY [DE]) 7 October 2010 (2010-10-07) cited in the application the whole document ----- -/-	1,2,6,7									
☒ 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 4 September 2012		Date of mailing of the international search report 02/01/2013									
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Raguin, Guy									

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/051902

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	MICHAELY HENRIK J ET AL: "Feasibility of gadofosveset-enhanced steady-state magnetic resonance angiography of the peripheral vessels at 3 Tesla with Dixon fat saturation", INVESTIGATIVE RADIOLOGY, LIPPINCOTT WILLIAMS & WILKINS, US, vol. 43, no. 9, 1 September 2008 (2008-09-01), pages 635-641, XP009151614, ISSN: 0020-9996 cited in the application the whole document -----	1,2,6,7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/051902

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010113048 A1	07-10-2010	CN 102369454 A	07-03-2012
		EP 2414860 A1	08-02-2012
		JP 2012521841 A	20-09-2012
		US 2012008847 A1	12-01-2012
		WO 2010113048 A1	07-10-2010

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/051902

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, 2, 6, 7(all partially)

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, 2, 6, 7(all partially)

A method, computer program and apparatus for performing contrast enhanced first pass magnetic resonance angiography comprising using a single-echo data acquisition technique, wherein the echo time of the one echo is flexible, and using a generalized Dixon water-fat separation technique for fat suppression in the reconstruction of an image.

2. claims: 3-5(completely); 1, 2, 6, 7(partially)

A method, computer program and apparatus for performing contrast enhanced first pass magnetic resonance angiography comprising using a multi-echo (in particular, dual-echo) data acquisition technique, wherein the echo times of the multiple echoes are flexible, and using a generalized Dixon water-fat separation technique for fat suppression in the reconstruction of an image.
