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(71) Applicant (for all designated States except US): SURF TECHNOLOGY AS [NO/NO]; Richard Birkelands veg 2b, 7491 Trondheim (NO).

(71) Applicant (for MG only): GARDINER, Stephen [GB/GB]; St. Bride's House, 10 Salisbury Square, London, Greater London EC4Y 8JD (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): ANGELSEN, Bjørn, A, J. [NO/NO]; Bugges veg 4b, N-7051 Trondheim (NO). HANSEN, Rune [NO/NO]; Wilhelm K Størens veg 11, N-7048 Trondheim (NO). TANGEN, Thor Andreas [NO/NO]; Griffenfelds gt. 1a, N-7012 Trondheim (NO).

(74) Agent: GARDINER, Stephen; St Bride's House, 10 Salisbury Square, London, Greater London EC4Y 8JD (GB).

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[Continued on next page]

(54) Title: METHOD FOR IMAGING OF NONLINEAR INTERACTION SCATTERING

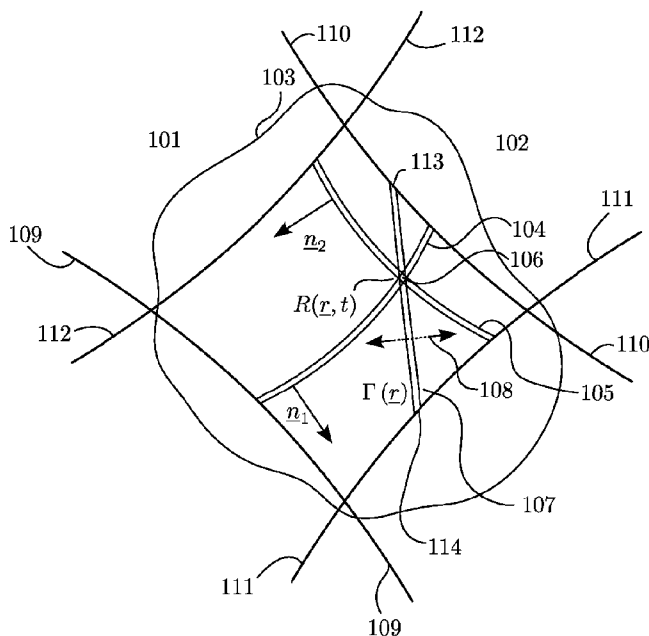


FIG. 1a

(57) Abstract: 1st and 2nd pulsed waves (105, 105) are transmitted along 1st and 2nd transmit beams (101, 102) where at least one of the beams is broad in at least one direction, and the transmit timing between said 1st and 2nd pulsed waves are selected so that the pulsed wave fronts overlap in an overlap region R(r,t) (106) that propagates along at least one measurement or image curve Γ(r) (107) in the material object. At least the scattered signal produced by nonlinear interaction between said 1st and 2nd waves in the overlap region (106) is received and processed to form a nonlinear interaction scattering image signal along Γ(r). The measurement or image curve Γ(r) (107) can be scanned laterally by either changing of the relative transmit timing between the 1st and 2nd pulsed waves (104, 105) or the direction of at least one of the 1st and 2nd transmit beams (101, 102), or both. The methods are applicable to image nonlinear scattering sources for both electromagnetic and elastic waves, and combinations of these.





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).

— *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))*

(88) Date of publication of the international search report:
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— *with international search report (Art. 21(3))*

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/051564

A. CLASSIFICATION OF SUBJECT MATTER
 INV. G01S7/52 G01S15/89 G01N21/00 G01N22/00 G01N29/00
 G01V1/00
 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)
 G01S G01N G01V
 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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/036244 A1 (ANGELSEN BJOERN A J [NO] ET AL) 11 February 2010 (2010-02-11)	1-5, 8-18, 20-33
Y	abstract; figures 1, 2a, 3a, 3b, 11, 12 paragraph [0045] - paragraph [0050] paragraphs [0054], [0057], [0085] paragraph [0089] - paragraph [0096] paragraphs [0105], [0108], [0112] paragraph [0120] - paragraph [0121] paragraph [0288] - paragraph [0295] paragraph [0298] - paragraph [0300] paragraph [0302]	6
Y	US 6 123 669 A (KANDA RYOICHI [JP]) 26 September 2000 (2000-09-26) abstract; figure 8 column 4, line 44 - column 5, line 41 column 6, line 5 - line 13 ----- -/--	6

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
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- "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 5 April 2012	Date of mailing of the international search report 20/07/2012
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 Knoll, Bernhard

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/051564

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/29433 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]) 11 April 2002 (2002-04-11)	1-3,5, 8-14,17, 20-30,32
Y	abstract; figures 1, 2a, 2b, 6a, 6b, 17, 18 page 3, line 25 - page 4, line 26 page 7, line 5 - page 8, line 29 page 10, line 24 - page 11, line 13 page 13, line 29 - page 14, line 33 -----	6
A	US 7 301 852 B2 (LEGGETT JAMES V [US] ET AL LEGGETT III JAMES V [US] ET AL) 27 November 2007 (2007-11-27) abstract; figure 3b column 7, line 61 - column 9, line 7 -----	1,12
A	US 5 601 086 A (PRETLOW III ROBERT A [US] ET AL) 11 February 1997 (1997-02-11) the whole document -----	1,12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/GB2011/051564

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010036244	A1	11-02-2010	NONE

US 6123669	A	26-09-2000	JP 4260920 B2 30-04-2009
			JP 11318889 A 24-11-1999
			US 6123669 A 26-09-2000

WO 0229433	A2	11-04-2002	EP 1330663 A2 30-07-2003
			JP 2004510514 A 08-04-2004
			US 2002040188 A1 04-04-2002
			WO 0229433 A2 11-04-2002

US 7301852	B2	27-11-2007	CA 2477468 A1 13-02-2005
			GB 2404983 A 16-02-2005
			GB 2420412 A 24-05-2006
			US 2005036403 A1 17-02-2005
			US 2008019216 A1 24-01-2008
			US 2008130409 A1 05-06-2008

US 5601086	A	11-02-1997	NONE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2011/051564

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.:

1-6, 8-18, 20, 22-33(completely); 21(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: 1-6, 8-18, 20, 22-33(completely); 21(partially)
nonlinear ultrasound imaging at an improved data acquisition rate

2. claim: 7
spatial resolution improvement in nonlinear ultrasound imaging

3. claim: 19
camera receive system

4. claim: 21(partially)
scatterer movement detection

5. claim: 34
measurement or imaging of nonlinear electromagnetic wave scattering
