



(43) International Publication Date  
27 September 2012 (27.09.2012)

- (51) International Patent Classification:  
*G06F 19/00* (2011.01) *G06F 3/14* (2006.01)
- (21) International Application Number:  
PCT/US2011/063062
- (22) International Filing Date:  
2 December 2011 (02.12.2011)
- (25) Filing Language:  
English
- (26) Publication Language:  
English
- (30) Priority Data:  
61/419,484 3 December 2010 (03.12.2010) US
- (71) Applicant (for all designated States except US): **UNIVERSITY OF DELAWARE** [US/US]; 1 Innovation Way, Delaware Technology Park, Building 1, Suite 500, Newark, DE 19711 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **BADIEY, Mohsen** [US/US]; 38 Hidden Valley Drive, Newark, DE 19711 (US). **KATSNELSON, Boris, G.** [RU/RU]; 249 Ap 12 Blvd. Pobeda, Voronezh, 394053 (RU).
- (74) Agents: **DONNELLY, Rex, A.** et al.; Ratnerprestia, P.O. Box 980, Valley Forge, PA 19482 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, 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.

(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:**

- 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))

(88) Date of publication of the international search report:  
27 December 2012

(54) Title: SIMULATOR AND METHOD FOR SIMULATING AN ACOUSTIC FIELD OF AN ACOUSTIC WAVEGUIDE

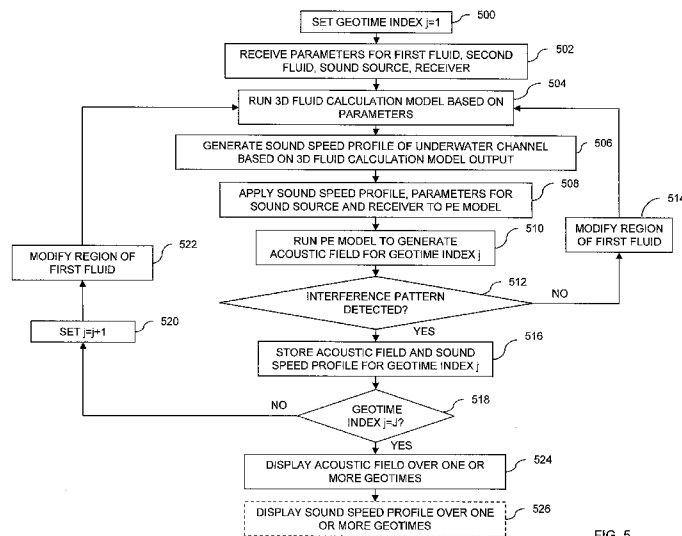


FIG. 5

(57) Abstract: Simulators and methods for simulating an acoustic field of an acoustic waveguide are provided. A sound speed profile of the acoustic waveguide is generated, where the acoustic waveguide has a region of a first fluid within a second fluid, and the first fluid has a different acoustic index of refraction than the second fluid. The sound speed profile and predetermined parameters of a sound source and a receiver are applied to a parabolic equation (PE) model of sound propagation in the acoustic waveguide. The acoustic field of the acoustic waveguide is determined from the PE model. The acoustic field includes an interference pattern from interference between an acoustic signal of the acoustic source and at least one signal refracted by the region of the second fluid.

WO 2012/128798 A3

**A. CLASSIFICATION OF SUBJECT MATTER***G06F 19/00(2011.01)i, G06F 3/14(2006.01)i*

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)

G06F 19/00; G01S 15/04; G01S 15/88; G03B 42/06; G01V 1/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) &amp; Keywords: acoustic waveguide, parabolic equation, fluid, speed

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006-0280030 A1 (NICHOLAS MAKRIS et al.) 14 December 2006 See abstract; paragraphs [0024]-[0041]; figures 1-3	1-22
A	US 2008-0239873 A1 (TSURUGAYA YOSHIKI et al.) 02 October 2008 See abstract; paragraphs [0041]-[0077]; figures 1-5	1-22
A	US 2009-0067290 A1 (LONDO SHAWN P. et al.) 12 March 2009 See abstract; paragraphs [0071]-[00106]; figures 1-4	1-22
A	US 05466157A A (HENDERSON; GERALD J. et al.) 14 November 1995 See abstract; column 3, line 28 - column 7, line 56; figures 1, 3	1-22

 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 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

23 OCTOBER 2012 (23.10.2012)

Date of mailing of the international search report

**23 OCTOBER 2012 (23.10.2012)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan  
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

JEON, Hyun Jin

Telephone No. 82-42-481-5845



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2011/063062**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0280030 A1	14.12.2006	US 7495994 B2	24.02.2009
US 2008-0239873 A1	02.10.2008	EP 1975645 A2	01.10.2008
		EP 1975645 A3	05.01.2011
		JP 2008-249532 A	16.10.2008
		US 7894303 B2	22.02.2011
US 2009-0067290 A1	12.03.2009	US 7606113 B2	20.10.2009
US 05466157A A	14.11.1995	US 05451164A A	19.09.1995
		US 05551881A A	03.09.1996
		US 05847975A A	08.12.1998