

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
9 February 2006 (09.02.2006)

PCT

(10) International Publication Number
WO 2006/014797 A3

(51) International Patent Classification:
G06F 17/50 (2006.01) **G06T 17/20** (2006.01)

(21) International Application Number:
PCT/US2005/026025

(22) International Filing Date: 22 July 2005 (22.07.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/898,235 26 July 2004 (26.07.2004) US

(71) Applicant (for all designated States except US): **THE BOEING COMPANY** [US/US]; 100 N. Riverside Plaza, Chicago, IL 60606 (US).

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **RASSAIAN, Mostafa** [US/US]; 17345 N.E. 17th Place, Bellevue, WA 98008 (US). **TWIGG, David, W.** [US/US]; 238 S. 299th Street, Federal Way, WA 98003 (US).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

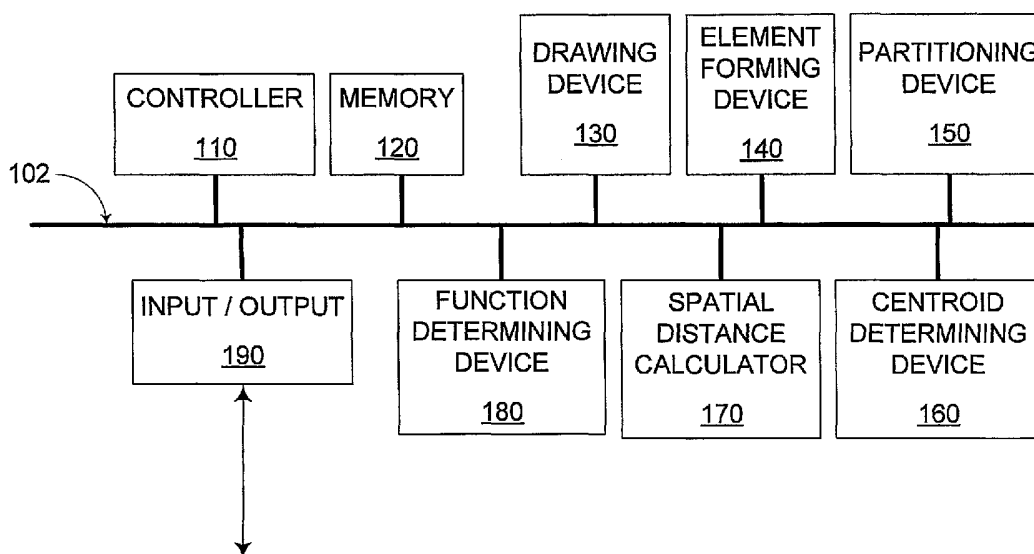
(74) Agents: **GUDMESTAD, Terje** et al.; The Boeing Company, 15460 Laguna Canyon Road, MC 1650-7006, Irvine, CA 92618 (US).

(88) Date of publication of the international search report:
13 July 2006

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: OBJECT ORIENTED ACOUSTIC MODELING TOOLS AND METHODS



(57) Abstract: Techniques for creating an acoustic model from a finite element mode include strategically partitioning elements of the finite element model into set, forming composite centroids from the partitioned elements and then calculating the spatial distances between the composite centroids so that an acoustic model can be created using a tiny portion of the computational power otherwise required. By further constraining the composite model to conform to an M-by-N array, object-oriented code can be used.

WO 2006/014797 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/026025

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F17/50 G06T17/20

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 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 practical, search terms used)

EPO-Internal, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	ANTON V. MOBLEY, MICHAEL P. CARROLL, AND SCOTT A. CANANN: "An object oriented approach to geometry defeaturing for finite element meshing" PROC. 7 TH INTL MESHING ROUNDTABLE, 26 October 1998 (1998-10-26), XP002378996 section 5; figure 10; table 1	1-32
Y	MJ PANTHAKI, R SAHU, WH GERSTLE: "An Object-Oriented Virtual Geometry Interface" PROCEEDINGS OF THE 6 TH ANNUAL INTERNATIONAL MESHING ROUNDTABLE, 13 October 1997 (1997-10-13), XP002378997 section 4.3.: "Mesh-based representation", paragraph 2 ----- -/--	1-32

☒ 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 document 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.

G document member of the same patent family

Date of the actual completion of the international search

5 May 2006

Date of mailing of the international search report

24/05/2006

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Wellisch, J.P.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/026025

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WELLISCH JP ET AL: "GEANT4 - a simulation toolkit" NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH, SECTION A (ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT) ELSEVIER NETHERLANDS, vol. 506, no. 3, 1 July 2003 (2003-07-01), pages 250-303, XP004431463 ISSN: 0168-9002 page 274, section 4.4.1.: "Tracking optimization"	6-8
Y	LEVOY M: "EFFICIENT RAY TRACING OF VOLUME DATA" ACM TRANSACTIONS ON GRAPHICS, ASSOCIATION FOR COMPUTING MACHINERY, NEW YORK, NY, US, vol. 9, no. 3, July 1990 (1990-07), pages 245-261, XP002913630 ISSN: 0730-0301 page 253, section 3, paragraph 3	6-8
A	MARBURG STEFFEN: "A general concept for design modification of shell meshes in structural-acoustic optimization - Part I: Formulation of the concept" FINITE ELEM ANAL DES; FINITE ELEMENTS IN ANALYSIS AND DESIGN JUNE 2002, vol. 38, no. 8, June 2002 (2002-06), pages 725-735, XP002379283 page 726, paragraph 1 section 3.	1,13,27, 32
A	MARBURG STEFFEN ET AL: "A general concept for design modification of shell meshes in structural-acoustic optimization - Part II: Application to a floor panel in sedan interior noise problems" FINITE ELEM ANAL DES; FINITE ELEMENTS IN ANALYSIS AND DESIGN JUNE 2002, vol. 38, no. 8, June 2002 (2002-06), pages 737-754, XP002379284 figures 3-7	1,13,27, 32
A	J.A. EATON, B.A. REGAN: "Application of the Finite Element Method to Acoustic Scattering Problems" AAIA JOURNAL, vol. 34, no. 1, 1 January 1996 (1996-01-01), pages 29-34, XP009065980 sections I, IV.	1,13,27, 32