



(51) International Patent Classification:

*A61B 8/08* (2006.01) *G01N 21/17* (2006.01)  
*A61B 5/00* (2006.01)

(SG). **NATIONAL UNIVERSITY HOSPITAL (SINGAPORE) PTE LTD** [SG/SG]; 1E Kent Ridge Road, #13-00, Singapore 119228 (SG).

(21) International Application Number:

PCT/SG2023/050006

(72) **Inventors: OLIVO, Malini**; c/o Institute of Bioengineering and Bioimaging, 11 Biopolis Way, Helios, #01-02, Singapore 138667 (SG). **GOH, Yong Geng**; c/o National University Hospital (Singapore) Pte Ltd, 1E, Kent Ridge Road, #13-00, Singapore 119228 (SG). **BALASUNDARAM, Ghayathri**; c/o Institute of Bioengineering and Bioimaging, 11 Biopolis Way, Helios, #01-02, Singapore 138667 (SG). **MOOTHANCHERY, Mohesh**; c/o Institute of Bioengineering and Bioimaging, 11 Biopolis Way, Helios, #01-02, Singapore 138667 (SG). **BI, Renzhe**; c/o Institute of Bioengineering and Bioimaging, 11 Biopolis Way, Helios, #01-02, Singapore 138667 (SG). **ZHANG, Ruochong**; c/o Institute of Bioengineering and Bioimaging, 11 Biopolis Way, Helios, #01-02, Singapore 138667 (SG).

(22) International Filing Date:

04 January 2023 (04.01.2023)

(25) Filing Language:

English

(26) Publication Language:

English

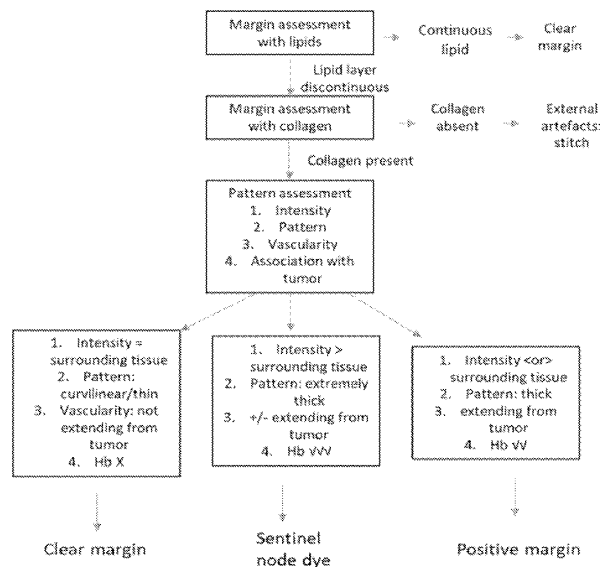
(30) Priority Data:

10202200190S 07 January 2022 (07.01.2022) SG

(71) **Applicants: AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH** [SG/SG]; 1 Fusionopolis Way, #20-10 Connexis North Tower, Singapore 138632

(54) **Title:** A SYSTEM AND A METHOD TO DISTINGUISH BETWEEN BENIGN AND MALIGNANT BREAST TUMORS

**FIG. 2**



(57) **Abstract:** Herein disclosed is an ex vivo method of identifying a state of a tumor margin in a sample. The method comprises operating a system to generate an ultrasound image and a photoacoustic image, wherein the system comprises: a probe configured to deliver a pulsed laser from a laser source to a sample, wherein the laser source is operable to generate the pulsed laser; arrays coupled to the probe, wherein one of the arrays comprises transducing elements arranged thereon which are operable to transmit and collect ultrasound signals, and wherein one of the arrays comprises transducing elements arranged thereon which are operable to collect photoacoustic signals; and a data acquisition module which converts the ultrasound signals and the photoacoustic signals into the ultrasound image and the photoacoustic image, respectively, identifying from the photoacoustic image the presence or absence of lipids and observing for a pattern and distribution of the lipids, identifying from the photoacoustic image the presence or absence of collagen

[Continued on next page]

(74) **Agent: VIERING, JENTSCHURA & PARTNER LLP;**  
P.O. Box 1088, Rochor Post Office, Rochor Road, Singapore 911833 (SG).

(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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, 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:**

21 September 2023 (21.09.2023)

and observing for a pattern and distribution of the collagen; identifying from the photoacoustic image the presence or absence of hemoglobin and observing for a pattern and distribution of the hemoglobin; and comparing from the photoacoustic image an intensity of the collagen and/or hemoglobin, if present, with an intensity of tissue proximal to the collagen and/or hemoglobin. Herein disclosed is a method of determining a state of a tumor.