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Datasheet for the decision of 21 June 2023

Case Number: T 2287/18 - 3.4.01

Application Number: 11745231.8

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Language of the proceedings: EN

Title of invention:
POINT SOURCE TRANSMISSION AND SPEED-OF-SOUND CORRECTION USING MULTI-APERTURE ULTRASOUND IMAGING

Applicant:
Maui Imaging, Inc.

Headword:
Ultrasound imaging / MAUI

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (yes)

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Case Number: T 2287/18 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 21 June 2023

Appellant: (Applicant)	Maui Imaging, Inc. 6280 San Ignacio Avenue, Suite E San Jose, CA 95119 (US)
Representative:	Potter Clarkson Chapel Quarter Mount Street Nottingham NG1 6HQ (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 26 March 2018 refusing European patent application No. 11745231.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair	P. Fontenay
Members:	B. Noll
	C. Almberg

Summary of Facts and Submissions

I. The application was refused on the ground of lack of inventive step (Article 56 EPC). The Examining Division found that the method of claim 1 of a main and an auxiliary request was obvious having regard to

D2: US 4831601A.

II. With a communication accompanying the summons to oral proceedings, the Board gave a preliminary assessment of the case.

III. Oral proceedings were held in person on the request of the appellant.

IV. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of the main request or the first auxiliary request underlying the appealed decision and re-filed with the statement of grounds of appeal or one of the second and third auxiliary requests filed for the first time with the letter of 30 September 2022.

V. Claim 1 of the main request reads (reference signs omitted):

A method of constructing an ultrasound image, comprising:

transmitting an omni-directional unfocused

ultrasound waveform approximating a first point source within a transmit aperture on a first array through a target region;

receiving ultrasound echoes from the target region with first and second receiving elements disposed on a first receive aperture on a second array, the second array being physically separated from the first array;

determining a first time for the waveform to propagate from the first point source to a first pixel location in the target region to the first receiving element, and determining a second time for the waveform to propagate from the first point source to the first pixel location in the target region to the second receiving element;

forming a first ultrasound image of the first pixel by coherently combining the echo received by the first receiving element at the first time with the echo received by the second receiving element at the second time;

receiving ultrasound echoes from the target region with third and fourth receiving elements disposed on a second receive aperture on a third array, the third array being physically separated from the first and second arrays;

determining a third time for the waveform to propagate from the first point source to the first pixel location in the target region to the third receiving element, and determining a

fourth time for the waveform to propagate from the first point source to the first pixel location in the target region to the fourth receiving element;

forming a second ultrasound image of the first pixel by coherently combining the echo received by the third receiving element at the third time with the echo received by the fourth receiving element at the fourth time; and

incoherently combining the first ultrasound image and the second ultrasound image.

VI. In view of the Board's decision, the auxiliary requests do not need to be reproduced.

Reasons for the Decision

1. D2 relates to an ultrasonic imaging device for diagnostic purpose and its operation. The device includes an apparatus for transmitting and receiving ultrasonic signals (fig. 1). The apparatus has a linear array 2 of emitting transducer elements 4 arranged along a longitudinal direction 3 (fig. 1) and an array 8 of transducer elements 10 (fig. 4) serving as ultrasonic receivers. The receiver elements 10 are arranged in columns parallel to the longitudinal direction and in rows perpendicular to it. The surface 6 of the array 2 defines a transmit aperture in the wording of claim 1. Similarly, the surface 12 of the

ultrasonic receiver arrays define a receive aperture. Figs. 2 and 3 show an apparatus with two arrays of ultrasonic receivers 8 symmetrically placed on either side of the array 2 of the transmitting transducer elements. The receiver elements 8 of a row 16 is connected to a corresponding controllable delay line 32 (fig. 4). The output signals from four adjacent receiver elements are combined, and all combined output signals are fed to a control and evaluating unit 30.

2. Regarding the method of claim 1 of the main request, D2 discloses a method of constructing an ultrasound image, by transmitting an ultrasound signal by a transducer on a first array 3 within a transmit aperture 6 through a target region (F, fig, 4) and receiving ultrasound echos from the target region with first and second receiving elements of a second array disposed on a first receive aperture being physically separated from the first array. The receiving transducer elements are, as shown in fig. 4, provided with electronically controllable delay lines 32 so that a synthetic focus F can be formed. Forming a synthetic focus implies that propagation times of the ultrasound signal from the emitting transducer to a pixel location in the target region to first and second receiving elements are determined. Fig. 4 further shows that, by superposing adding signals of four adjacent receiving elements to a common signal, a first ultrasound image of a first pixel is formed. The signals in each of the two arrays 8 shown in fig. 3 are processed in this scheme. Therefore, D2 discloses the steps of receiving, determining and forming a second ultrasound image of claim 1.

3. The Examining Division argued that the array 2 in D2 comprised a single transducer element 10 in a direction

perpendicular to the longitudinal direction 3 and that the ultrasounds emitted in the longitudinal direction did not imply phased array focusing. Therefore, a single transducer element 10 in D2 was a point source so that D2 disclosed the emission of an omni-directional unfocused waveform.

4. The Board disagrees. As correctly noted by the Examining Division, an emitter designed as a point source generates an omnidirectional unfocused wavefront. However, the Board is not persuaded that a single transducer element 4 in D2 is indeed designed in this sense. The description relating to fig. 4 refers to a beam axis associated with the transducer elements 4, with the ultrasonic signal emitted from the array 2 propagating along the beam axis towards the virtual focus F. D2 does not show that ultrasound is intentionally emitted in directions out of this beam to regions beneath the arrays 8 in fig. 4 as it would be expected for sound propagating omni-directionally. Rather, the description, column 1, lines 18 - 43, describes large-area transducers having a curved surface which inherently focus the emitted ultrasound signal. It can, therefore, not be reasonably assumed that the transducers in D2 implicitly have a point-source characteristic. Therefore, an excitation of an omni-directional, unfocused ultrasound signal is not directly and unambiguously derivable from D2.

5. Accordingly, the method of claim 1 differs from D2 by transmitting an omni-directional unfocused ultrasound waveform approximating a first point source and by coherently combining the echos received by the receiving elements from selected pixels to obtain a first and second ultrasound image and by eventually

combining the first ultrasound image and the second ultrasound image.

6. The application describes (description, paragraph 7), that ultrasound methods using a transducer array having a large aperture suffer from a variation of speed of sound of the tissue between the probe and the region of interest. This results in difficulties of phase control of the elements of the transducer array and, hence, of a decrease of image quality. The invention seeks to overcome this difficulty. Therefore, the problem to be solved by the claimed method may be considered as to improve image quality.

7. D2 does not give the skilled person any indication of the above distinguishing features. Even though it may be considered that a combination of image signals was generally known in the field of ultrasound image processing to reduce speckle noise, this would not have led the skilled person to consider transmission of an omni-directional unfocused waveform approximating a point source. Therefore, the method of claim 1 was not obvious to the skilled person.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division with the order to grant a patent on the basis of the main request, and with the description and drawings to be adapted as necessary.

The Registrar: The Chair:

D. Meyfarth P. Fontenay

Decision electronically authenticated