US 20180289357A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2018/0289357 A1
(43) Pub. Date: Oct. 11, 2018
JENSEN et al.

(54) ULTRASOUND IMAGING SYSTEM PROBE CABLE AND CONNECTOR

(71) Applicant: **B-K Medical Aps**, Herlev (DK)

(72) Inventors: **Henrik JENSEN**, Nordhavn (DK); **Robert Harold OWEN**, Stenlose (DK); **Soren Juel ANDERSEN**, Kobenhavn NV (DK); **Christopher BEERS**, State College, PA (US); **Niels Christian SASADY**, Frederiksberg (DK); **Per Ehrenreich NYGAARD**, Soeberg (DK)

(73) Assignee: **B-K Medical Aps**, Herlev (DK)

(21) Appl. No.: **15/479,818**

(22) Filed: **Apr. 5, 2017**

Publication Classification

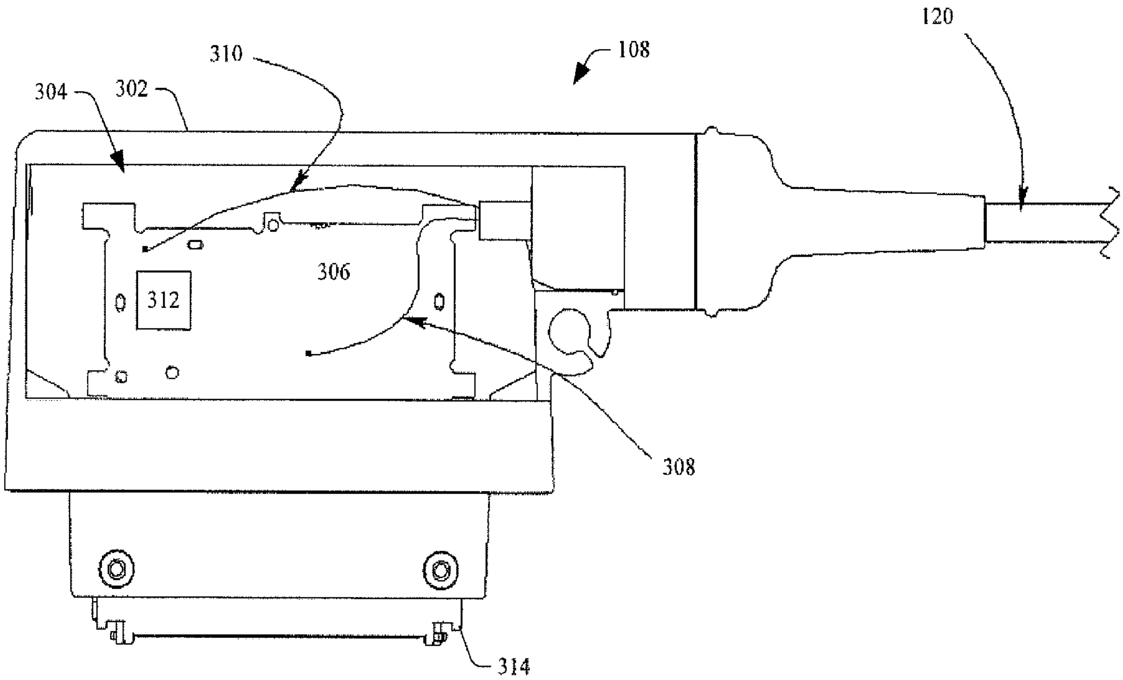
(51) **Int. Cl.**

A61B 8/00	(2006.01)
A61B 8/12	(2006.01)
A61B 8/14	(2006.01)
A61B 1/313	(2006.01)
A61B 5/06	(2006.01)

(52) **U.S. Cl.**
CPC *A61B 8/4444* (2013.01); *A61B 8/12* (2013.01); *A61B 8/4483* (2013.01); *A61B 5/062* (2013.01); *A61B 1/3132* (2013.01); *A61B 8/461* (2013.01); *A61B 8/14* (2013.01)

(57) **ABSTRACT**

An ultrasound probe includes a housing. The housing includes a first end, which internally houses: a transducer array and a tracking sensor, and a second end. The housing further includes a second portion extending between the first and second ends. The second portion houses: a first electrically conductive path extending from the transducer array through the second portion to the second end, which is opposite the first end, and a second electrically conductive path extending from the tracking sensor through the second portion to the second end. The probe further includes a single electro-mechanical connector with a physical interface configured to transfer signals carried by the first and second electrically conductive members off the probe. The probe further includes a single cable that routes the first and second electrically conductive members from the second end to the electro-mechanical connector.



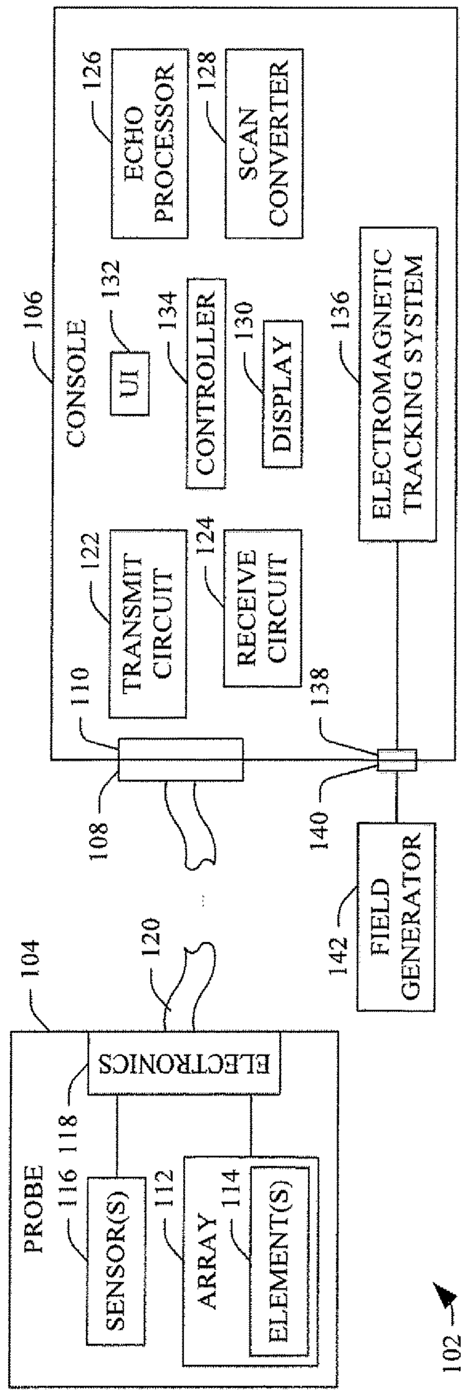


FIGURE 1

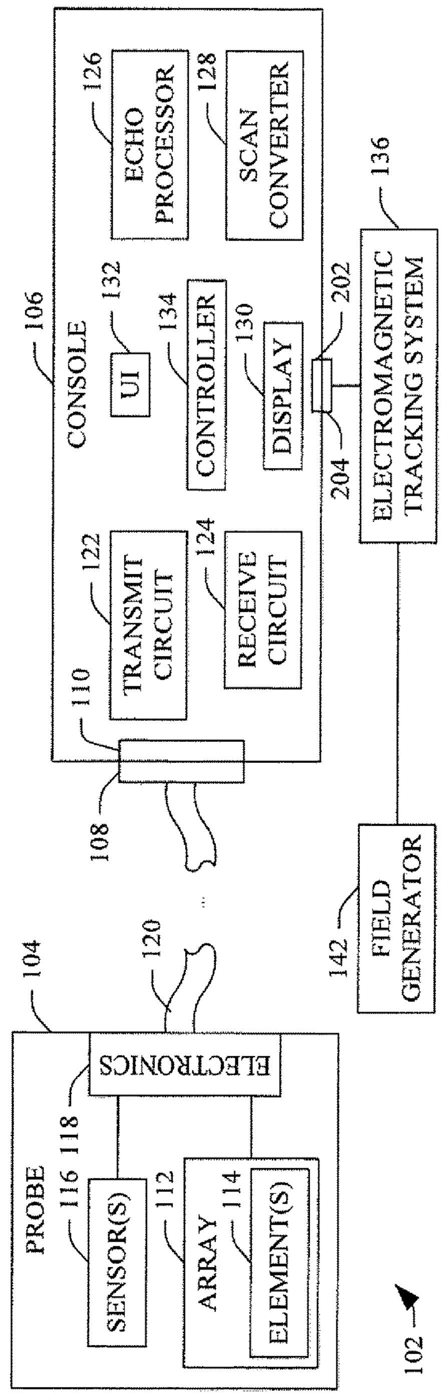


FIGURE 2

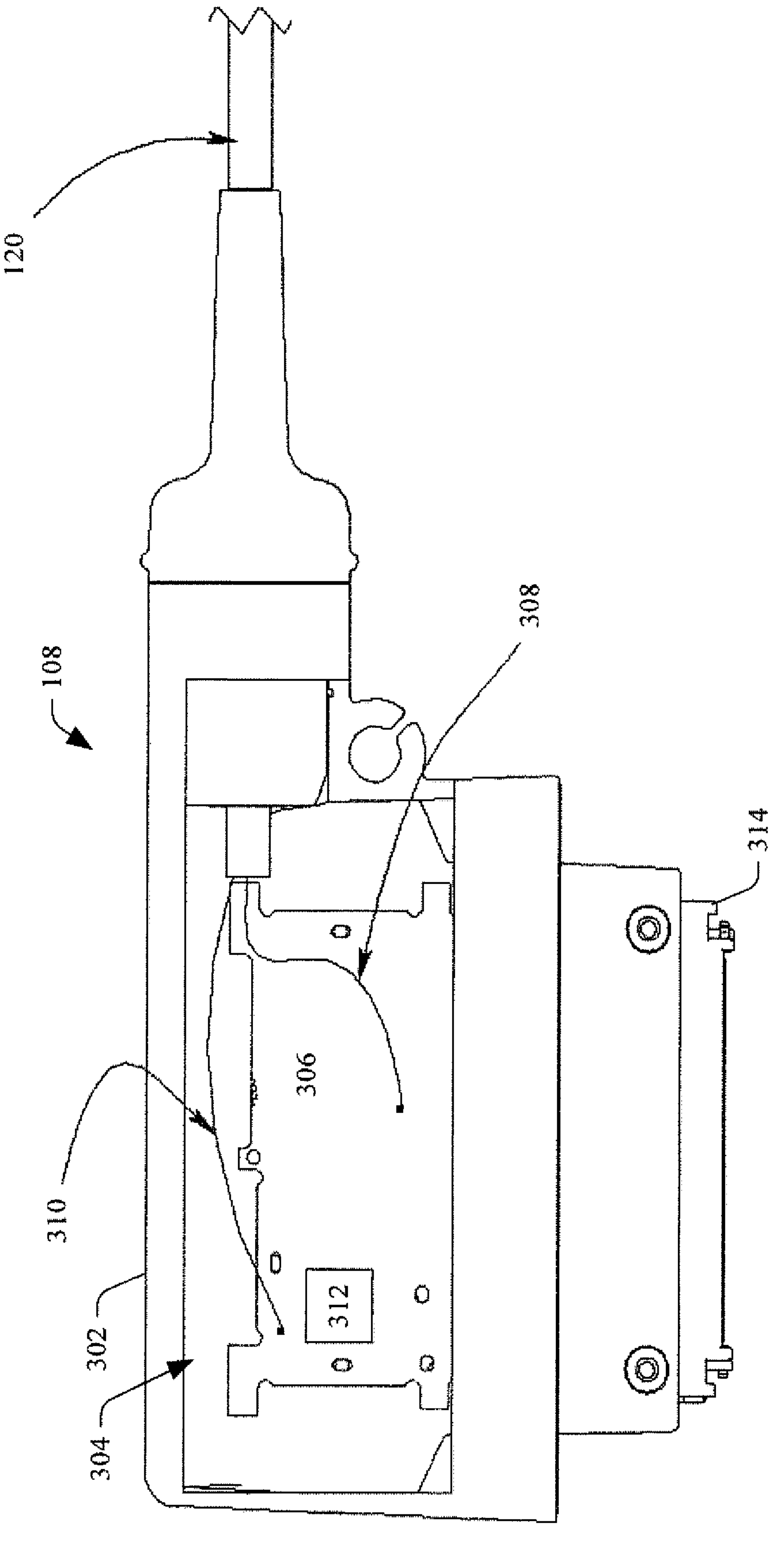


FIGURE 3

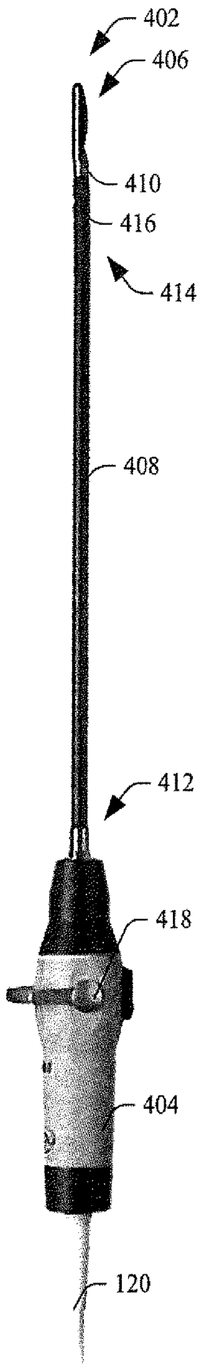


FIGURE 4

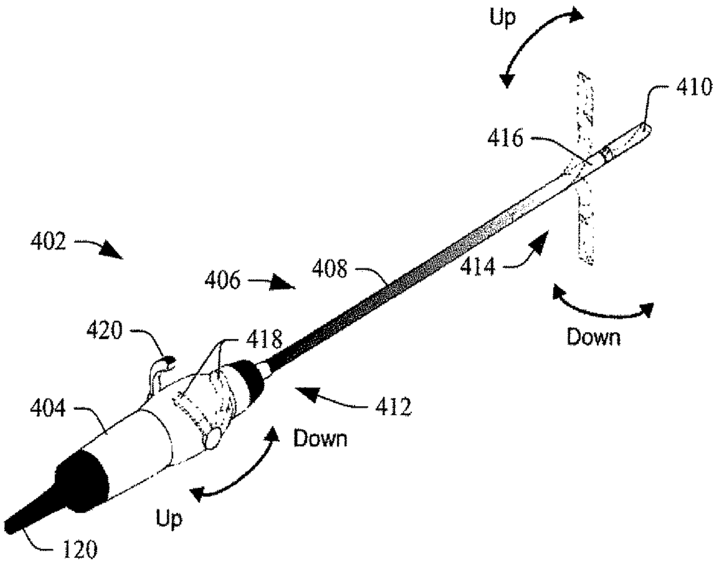


FIGURE 5

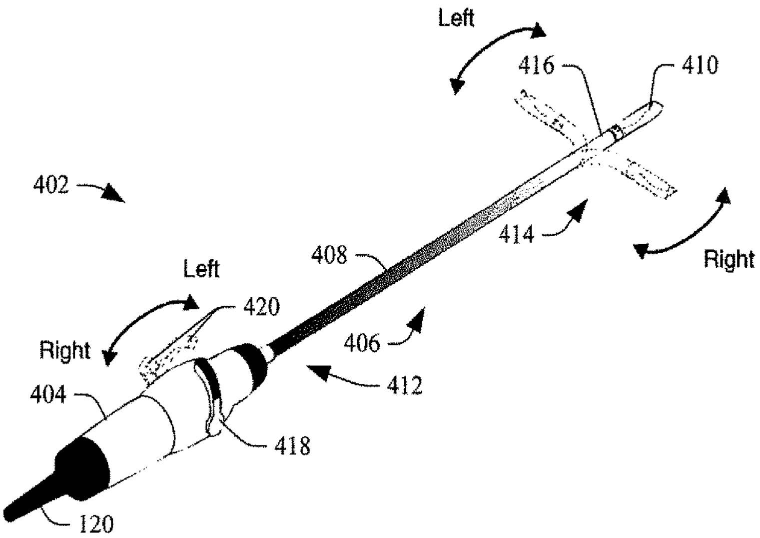


FIGURE 6

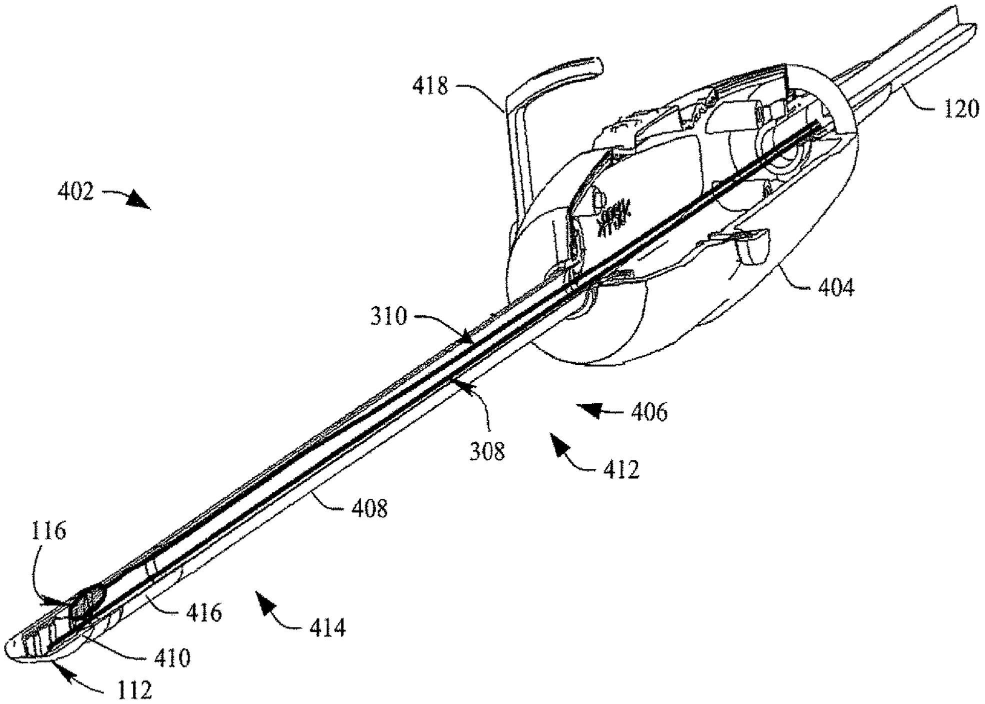


FIGURE 7

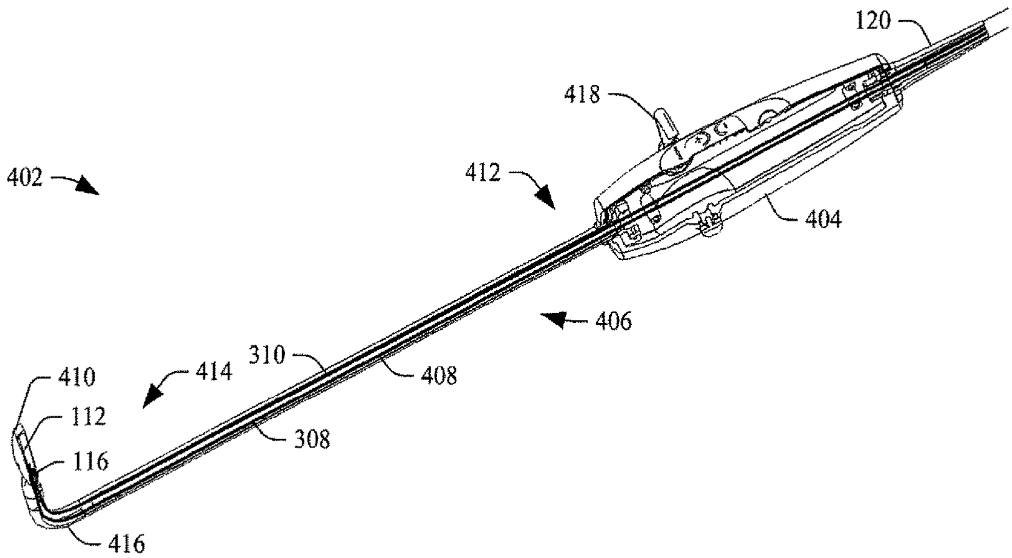


FIGURE 8

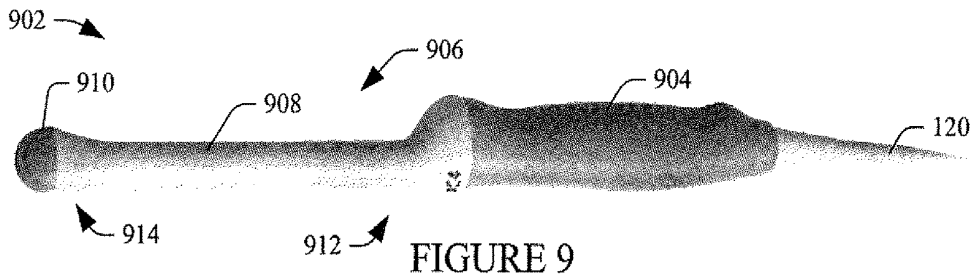


FIGURE 9

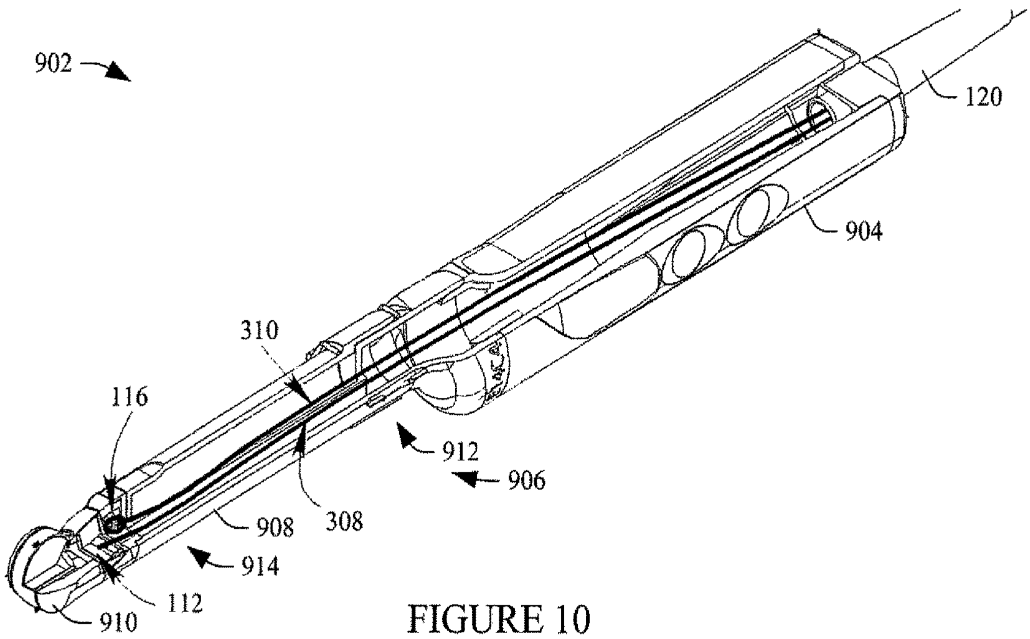


FIGURE 10

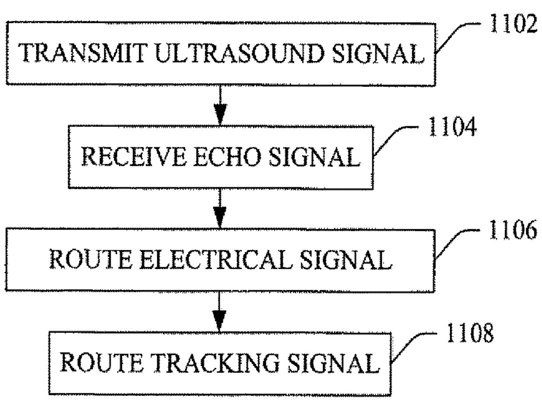


FIGURE 11

ULTRASOUND IMAGING SYSTEM PROBE CABLE AND CONNECTOR

TECHNICAL FIELD

[0001] The following generally relates to ultrasound imaging and more particularly to an ultrasound imaging system probe with a single cable and a single connector configured to transfer both an electrical signal indicative of a received echo and a tracking signal.

BACKGROUND

[0002] An ultrasound imaging system has included an ultrasound probe with a transducer array and a console. The ultrasound probe houses the transducer array, and the console includes a display monitor and a user interface. The transducer array transmits an ultrasound signal and receives echoes produced in response to the signal interacting with structure. The echoes are converted to electrical signals by the transducer array and are conveyed to the console. The electrical signals are routed via wires from the transducer array through a cable to an electromechanical connector electrically and mechanically connected to a complementary electromechanical connector of the console.

[0003] With some applications, a separate tracking system is used to spatially track the probe. A typical electromagnetic tracking system includes of a control unit, a field generator, and a sensor(s), which is affixed to the probe. The control unit processes the signal to the field generator and the signal from the sensor(s) to determine a spatial position of the sensor(s) relative to the field generator. In one system, the tracking sensor is temporarily attached on an outside of the probe via a click-on bracket or tape. However, the click-on sensor may be cumbersome to clean and/or in the way of a needle guide and/or and a sterile cover.

[0004] Furthermore, there are now two cables to manage (one for the array and one for the tracking sensor), and the cables, the sensor, and the click-on bracket consume space. Furthermore, the measurement may be imprecise as the sensor may have to be placed some distance from the active part of the ultrasound transducer, which generally is what it is desired to be tracked. Generally, using a tracking system with an ultrasound system adds the complexity of attaching sensors to the ultrasound probe, connecting the sensor, connecting the magnetic field generator, interconnecting the tracking and the ultrasound system, configuring system, calibration or registration, etc.

SUMMARY

[0005] Aspects of the application address the above matters, and others.

[0006] In one aspect, an ultrasound probe includes a housing. The housing includes a first end, which internally houses: a transducer array and a tracking sensor, and a second end. The housing further includes a second portion extending between the first and second ends. The second portion houses: a first electrically conductive path extending from the transducer array through the second portion to the second end, which is opposite the first end, and a second electrically conductive path extending from the tracking sensor through the second portion to the second end. The probe further includes a single electro-mechanical connector with a physical interface configured to transfer signals carried by the first and second electrically conductive members off the probe. The probe further includes a single cable that routes the first and second electrically conductive members from the second end to the electro-mechanical connector.

[0007] In another aspect, a probe including an elongate shaft with first and second ends, and a head disposed at one of the first or second ends, wherein the head encloses a transducer array and a tracking sensor. The probe further includes a handle disposed at the other of the first or second ends. The probe further includes a single cable extending from the handle to a single connector of the single cable. The probe further includes first and second electrically conductive elements extending inside of the head, the shaft, the handle, the single cable and the single connector, respectively from the transducer array and the tracking sensor to a circuit board disposed inside of the single connector.

[0008] In another aspect, a method includes transmitting, with a transducer array of a probe, an ultrasound signal in response to a transmit pulse. The method further includes receiving, with the transducer array, an echo signal produced in response to an interaction of the ultrasound signal with structure, and generating, with the transducer array, an electrical signal indicative of the receive echo signal. The method further includes routing, via a first electrically conductive pathway inside of the probe, the electrical signal from the transducer array to a readout connector of a cable of the probe, and routing, via a second electrically conductive pathway inside of the probe, a tracking signal from a tracking sensor proximate to the transducer array to the same readout connector inside of the same cable of the probe. The method further includes transferring the electrical signal and the tracking signal off the probe through the same readout connector.

[0009] Those skilled in the art will recognize still other aspects of the present application upon reading and understanding the attached description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The application is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

[0011] FIG. **1** schematically illustrates an example ultrasound imaging system with an integrated tracking system and a probe with an integrated tracking sensor where a transducer array and the tracking sensor of the probe are connected to a console via a single cable and a single cable connector;

[0012] FIG. **2** schematically illustrates a variation of FIG. **1** in which the tracking system is located external from the console;

[0013] FIG. **3** illustrates an example of the single cable connector;

[0014] FIG. **4** illustrates a side view of an example laparoscopic probe;

[0015] FIG. **5** schematically illustrates a perspective view of the probe of FIG. **4** showing up/down articulation of a head of the probe;

[0016] FIG. **6** schematically illustrates a perspective view of the probe of FIG. **4** showing right/left articulation of a head of the probe;

[0017] FIG. **7** illustrates example of the probe of FIG. **4** with a cut-away showing example sensor placement and routing of a wire therefrom to the cable;

[0018] FIG. **8** illustrates the probe of FIG. **7** with the tip articulated;

[0019] FIG. **9** illustrates an example endocavitary probe;

[0020] FIG. **10** illustrates example of the probe of FIG. **8** with a cut-away showing example sensor placement and routing of a wire therefrom to the cable; and

[0021] FIG. **11** illustrates an example method in accordance with an embodiment herein.

DETAILED DESCRIPTION

[0022] FIG. **1** schematically illustrates an imaging system **102** such as ultrasound imaging system. The imaging system **102** includes an ultrasound probe **104** and a console **106**.

[0023] In general, the probe **104** can be any type of ultrasound imaging probe. For explanatory purposes and sake of brevity and clarity, the probe **104** is described with particular application to laparoscopic and endocavitary ultrasound imaging probes. However, it is to be understood that the probe **104** is not limited to laparoscopic and/or endocavitary ultrasound imaging probes, or the laparoscopic and/or endocavitary ultrasound imaging probes described herein. Non-limiting examples of ultrasound applications include image fusion (e.g., ultrasound and magnetic resonance (MR)), instrument (e.g., biopsy needle, ablation device, etc.) tracking, and/or other ultrasound applications.

[0024] The ultrasound probe **104** includes a transducer array **112** with a transducer element(s) **114**, a tracking (electro-magnetic) sensor(s) **116**, and electronics **118**. The tracking sensor(s) **116** is integrated inside of the probe **104**. In one instance, the tracking sensor(s) **116** is integrated and/or disposed in the probe **104** proximate of the transducer element(s) **114**. In another instance, the tracking sensor(s) **116** is disposed in the probe **104** distal to the transducer element(s) **114**. Integrating the tracking sensor(s) **116** in the probe **104** as such, in one instance, can eliminate a need for a click-on bracket and/or other mechanism for attaching the tracking sensor(s) **116** on the outside of the probe **104**.

[0025] The electronics **118** receives and routes signals from the transducer element(s) **114** and from the tracking sensor(s) **116** (analog signals or digitized versions thereof) to wires (not visible) of a same single cable **120** that terminate at a circuit board (not visible) in a same single electro-mechanical connector **108** at an end of the cable **120**. In one instance, routing the signals in the same cable **120** may improve cable management and/or make it easier to clean relative to a configuration with separate cables. As described in greater detail below, the signals from the transducer element(s) **114** and the tracking sensor(s) **116** (the analog or the digitized signals) are transferred off the probe **104** via the same single electro-mechanical connector **108**.

[0026] The console **106** includes a complementary electro-mechanical connector **110**. For example, in one instance the connectors **108** and **110** are configured as plug and socket connectors, where the connector **108** has a "male" configuration and is a plug with electrically conductive pins or prongs, and the complementary connector **110** has a "female" configuration and is a mating receptacle with electrically conductive sockets configured to receive the pins or prongs. Mechanically engaging the connectors **108** and **110** places the pins/prongs and sockets in electrical communication. Other configurations are also contemplated herein. The signals are conveyed from the probe **104** to the console **106** via the connectors **108** and **110**.

[0027] The console **106** further includes a transmit circuit **122** and a receive circuit **124**. The transmit circuit **122** transmits a control signal(s), via the cable **120** and to the probe **104**, that excites one or more of the transducer element(s) **114** of the transducer array **112**, which causes the transducer element(s) **114** to transmit an ultrasound signal or pressure wave. The receive circuit **124** receives, via the cable **120**, the electrical signals produced by the element(s) **114** of the transducer array **112**, which are indicative of the echoes received by the element(s) **114** of the transducer array **112**.

[0028] The console **106** further includes an echo processor **126** that processes the received electrical signals. With B-mode imaging, such processing includes beamforming such as delay and sum beamforming of the electrical signals, which produce a sequence of focused, coherent echo samples along focused scanlines of a scanplane. Other processing may process the electrical signal for A-mode, C-plane, Doppler, etc. applications. Other processing may lower speckle, improve specular reflector delineation, and/or includes FIR filtering, IIR filtering, etc. The signals can first be amplified and/or otherwise pre-processed and/or conditioned.

[0029] The console **106** further includes a scan converter **128** that scan converts frames of data to generate data for a display **130**. The console **106** further includes a user interface (UI) **132** with one or more input devices (e.g., a button, a knob, a touchscreen, etc.) and/or one or more output devices (e.g., a display monitor, an audio presenter, etc.), which allows for interaction with the system **102**. The console **106** further includes a controller **134** that controls at least one of the transmit circuit **122**, the receive circuit **124**, the echo processor **126**, the scan converter **128**, the display **130** and/or the user interface **132**.

[0030] The console **106** further includes an integrated electromagnetic tracking system **136** and an electro-mechanical interface **138** configured to mechanically engage and electrically communicate with a complementary electro-mechanical interface **140** of a field generator **142**, which is external to the console **106**. The interfaces **138** and **140** can be electro-mechanical connectors as described herein and/or otherwise. The controller **134** synchronizes the processing of the signals from the tracking sensor(s) **116** and the generating the electro-magnetic field by the field generator **142**. An example electromagnetic tracking system is the Aurora tracking system, a product of NDI, which is headquartered in Ontario, Canada.

[0031] FIG. **2** shows a variation of the configuration shown in FIG. **1** in which the electromagnetic tracking system **136** is external to the console **106**. In this variation, the console **106** includes an electro-mechanical interface **202** configured to mechanically engage and electrically communicate with a complementary electro-mechanical interface **204** of the electromagnetic tracking system **136**. The electromagnetic tracking system **136**, similar to FIG. **1**, controls the field generator **142**, which is external to the console **106**. The interfaces **138** and **140** can be electro-mechanical connectors as described herein and/or otherwise.

[0032] FIG. **3** schematically illustrates an example of the electro-mechanical connector **108** of the probe **104**.

[0033] The illustrated connector **108** includes a housing **302**. A region **304** of the housing **302** is shown transparent so that a portion of an inside of the probe **104** is visible in the drawing. The connector **108** further includes a circuit board(s) **306**. A first set of wires **308** from the cable **120** routes signals between the circuit board(s) **306** and the console **106**. A second set of wires **310** from the same cable **120** routes signals between the same circuit board(s) **306** and the console **106**. In the illustrated embodiment, circuitry **312** converts analog signals from the tracking sensor(s) **116** to digital signals. In one instance, the conversion includes reducing the amount of data and converting the signals to coordinates, which mitigates transmitting sensor signals across the connectors **108** and **110**.

[0034] The circuit board(s) **306** routes the signals from the transducer array **112** and the digitized tracking sensor signals to pins or sockets (not visible) recessed within a portion **314** of the connector **108**, which is configured to mechanically engage a complementary portion of the complementary electro-mechanical connector **110** of the console (FIGS. **1** and **2**). The circuit board(s) **306** also routes control, power, etc. signals from the complementary electro-mechanical connector **110** of the console (FIGS. **1** and **2**) received by the pins or sockets (not visible) recessed within the portion **314** to the first and second sets of wires **308** and **310**.

[0035] In this example, signals are transferred from the circuit board(s) **306** over a bus, such as the serial peripheral interface (SPI) bus or other synchronous serial communication interface. In one instance, the circuitry **312** includes hardware built around the SPI bus. This hardware provides gating controlled by a pair of differential signals. The gating, in one instance, mitigates noise during receive and/or mitigates disturbances in the transmit pulse during transmit. In this example, the communications link triggers with a 5-15 MHz clock, such as a 10 MHz clock, and operates through cycles of Transmit (TX), Receive (RX), and Communicate operations, using the same channels or electrodes of the connectors **108** and **110**. Table 1 describes an example configuration of the pinout of the connector **108**.

TABLE 1

Example configuration of the pinout.

Pin(s)	Name	Description
D3	$+5V_D$	+5V supply for the digital circuitry (probe control logic) referenced to noisy ground.
D4	SafeGate−	Differential signal to gate single ended control signals
D5	SafeGate+	during the transmit pulse and receive period.
C4	S_SCK	SPI data clock from master.
C5	S_SS−	SPI device select enable signal. Active low.
D1	S_MOSI	SPI Master Output, Slave data Input signal line. Data to slave from master.
D2	S_MISO	SPI Master Input, Slave data Output signal line. Data from slave to master.
C3	INT−	Active low interupt signal from the probe to the console to indicate that data is available on the SPI bus. This signal has a strong pull-up on the console side.

[0036] A size of the circuit board(s) **306** is such that it fits within a same housing of a probe not including the circuit board(s) **306**. That is, the footprint of the probe **104** does not change. Furthermore, the connector **108** does not require any modification to the pinout relative to a probe not including the circuit board(s) **306**, and the connector **110** does not require any modification to transfer data between the probe **104** and the console **106**. The circuit board(s) **306**, in the configuration described herein, includes the circuitry **312** for controlling data transfer (e.g., the TX, RX, and communicate cycle), digitizes the tracking signal (for configurations which digitize the tracking signal), and supplies power for the tracking sensor **116**, etc.

[0037] FIGS. **4**, **5**, **6**, **7** and **8** illustrate an example of the probe **104**. FIG. **4** illustrates a side view of the probe **104**. FIG. **5** illustrates a perspective view of the probe **104** showing up and down articulation. FIG. **6** illustrates a perspective view of the probe **104** showing right and left articulation. FIG. **7** schematically illustrates a perspective view of a non-articulated probe **104** with a cut-out showing a portion of an inside of the probe **104**. FIG. **8** schematically illustrates a perspective view of an articulated probe **104** with a cut-out showing a portion of an inside of the probe **104**. In FIGS. **4**, **5**, **6**, **7** and **8**, the probe **104** is configured as a laparoscopic probe **402**.

[0038] With reference to FIGS. **4**, **5**, **6**, **7** and **8**, the laparoscopic probe **402** includes a handle **404** and an elongate shaft **406** having a long axis. The elongate shaft **406** includes a body **408** and a head **410**, both aligned along the long axis. The body **408** includes a first end **412** and a second opposing end **414**. The first end **412** of the body is affixed to the handle **404**. An articulating member **416** couples the second end **414** of the body and the head **410**. In the illustrated embodiment, the articulating member **416** articulates in at least four directions (up, down, right and left). In a variation, the articulating member **416** articulates in at least two directions. In a variation, the articulating member **416** is omitted and the shaft **406** is rigid and does not articulate.

[0039] The handle **404** includes a first actuator **418** and a second actuator **420**. The first actuator **418** actuates the articulating member **416** to control up/down movement of the head **410**. The second actuator **420** actuates the articulating member **416** to control left/right movement of the head **410**. An example of such a probe is the I12C4f 4-way laparoscopic probe, a product of B-K Medical ApS, a company of Herlev, Denmark, which is a wholly owned subsidiary of Analogic Corporation, a company of MA, USA. Other laparoscopic probes are also contemplated herein. FIGS. **7** and **8** schematically illustrate the transducer array **112** and the tracking sensor(s) **116** and routing of wires **308** and **310** from inside of the head **410** through inside of the body **408** and the handle **404** to inside of the cable **120**; the transducer array **112**, the tracking sensor(s) **116** and the wires **308** and **310** are housed inside of the probe **402**.

[0040] In FIGS. **7** and **8**, the mechanism for articulating the articulating member **416** is omitted for sake of clarity. An example approach for articulating a head of a transducer probe is described in patent application Ser. No. 14/232,034, published as US 2014/0133269 A1, filed Jul. 12, 2011, and entitled "Ultrasound Imaging Probe," and patent application Ser. No. 14/760,550, published as US 2015/0335312 A1, filed Jan. 14, 2013, and entitled "Ultrasound Imaging Probe, and patent application Ser. No. 14/232,034, published as US 2014/0133269 A1, filed Jul. 12, 2011, and entitled "Ultrasound Imaging Probe," which are incorporated herein by reference in their entireties.

[0041] FIGS. **9** and **10** illustrate another example of the ultrasound imaging probe **104**. FIG. **9** illustrates a side view of the probe **104**, and FIG. **10** schematically illustrates a perspective view with a cut-out showing a portion of an inside of the probe **104**. In this example, the probe **104** is configured as an endocavitary probe **902**.

[0042] The endocavitary probe **902** includes a handle **904** and an elongate shaft **906** having a long axis. The elongate shaft **906** includes a body **908** and a head **910**, both aligned along the long axis. The body **908** includes a first end **912** and a second opposing end **914**. The first end **912** of the body is affixed to the handle **904**. FIGS. **9** and **10** also schematically illustrate the transducer array **112** and the tracking sensor(s) **116** and routing of the wires **308** and **310**, respectively therefrom, from inside of the head **910** through inside of the body **908** of the shaft **906** and the handle **904** to the cable **120**; the transducer array **112**, the tracking sensor(s) **116** and the wires **308** and **310** are housed inside of the probe **902**.

[0043] An example of such a probe is the E10C4 Endocavitary probe, a product of B-K Medical ApS, a company of Herlev, Denmark, which is a wholly owned subsidiary of Analogic Corporation, a company of MA, USA. Another suitable probe is the E14CL4b Endocavitary Biplane probe, a product of B-K Medical ApS, which is a wholly owned subsidiary of Analogic Corporation, a company of MA, USA. The E14CL4b Endocavitary Biplane probe include two transducer arrays. An example of an endocavitary probe is described in patent application Ser. No. 12/225,488, U.S. Pat. No. 9,259,208 B1, filed Oct. 20, 2009, and entitled "Ultrasound Probe," which is incorporated herein by reference in its entirety. Other endocavitary probes are also contemplated herein.

[0044] The approached described herein includes integrating a tracking sensor(s) **116** in an ultrasound imaging probe **104** with the transducer array **112**, routing signals from both through the same single cable **120** to the same single interface **108**, which is configured to connect to the complementary same single interface **110** of the console **106**, which transmits at least ultrasound signals and sensor signals via the connection therebetween to the console **106**. In one instance, this mitigates the complexity of attaching a sensor (s) **116** to the ultrasound probe **104**, connecting the sensor(s) **116**, managing two cables, connecting the magnetic field generator **142**, interconnecting the tracking and the ultrasound system **136** and **102**, configuring the system **102**, calibration or registration, etc. associated with a configuration in which the same single cable **120** and the same single interface **108** are not utilized. By fully integrating the sensor(s) **116** in the ultrasound probe **104**, the handling of it is completely taken out of the complexity.

[0045] FIG. **11** illustrates a method in accordance with an embodiment described herein.

[0046] It is to be appreciated that the order of the following acts is provided for explanatory purposes and is not limiting. As such, one or more of the following acts may occur in a different order. Furthermore, one or more of the following acts may be omitted and/or one or more additional acts may be added.

[0047] At **1102**, transmit an ultrasound signal with the transducer array **112**.

[0048] At **1104**, receive an echo signal with the transducer array **112**.

[0049] At **1106**, route the electrical signal indicative of the echo signal to the console **106** via the set of conductive members or elements **308**, the connectors **108** and **110** and the cable **120**

[0050] At **1108**, route the tracking signal to the console **106** via the set of conductive members or elements **310**, the connectors **108** and **110** and the cable **120**.

[0051] The application has been described with reference to various embodiments. Modifications and alterations will occur to others upon reading the application. It is intended that the invention be construed as including all such modifications and alterations, including insofar as they come within the scope of the appended claims and the equivalents thereof.

What is claimed is:

1. An ultrasound probe, comprising:
- a housing, including:
  - a first end, which houses:
    - a transducer array; and
    - a tracking sensor;
  - a second end;
  - a mid-portion extending between the first and second ends, wherein the second portion houses:
    - a first electrically conductive member extending from the transducer array through the mid-portion to the second end, which is opposite the first end;
    - a second electrically conductive member extending from the tracking sensor through the mid-portion to the second end;
- a single electro-mechanical connector with a physical interface configured to transfer signals carried by the first and second electrically conductive members off the probe; and
- a single cable that routes the first and second electrically conductive members from the second end to the electro-mechanical connector.

2. The ultrasound probe of claim **1**, wherein the tracking sensor is disposed inside of the head proximate to the transducer array.

3. The ultrasound probe of claim **1**, wherein the tracking sensor is integrated with the transducer array inside of the head.

4. The ultrasound probe of claim **1**, wherein the first end, including a portion thereof physically supporting the tracking sensor and the transducer array, is configured to articulate relative to the mid-portion.

5. The ultrasound probe of claim **1**, wherein the first end, including a portion thereof physically supporting the tracking sensor and the transducer array, is not capable of articulating relative to the mid-portion.

6. The ultrasound probe of claim **1**, wherein the single electro-mechanical connector houses a circuit board, which is in electrical communication with the first and second electrically conductive members and the physical interface.

7. The ultrasound probe of claim **6**, wherein the circuit board includes electronics configured to convert an analog tracking signal into a digital tracking signal.

8. The ultrasound probe of claim **7**, wherein the electronics is configured to convert the analog tracking signal to digital coordinates.

9. The ultrasound probe of claim **6**, wherein the circuit board includes electronics configured to control transfer of data off and onto the circuit board.

10. The ultrasound probe of claim **9**, wherein the electronics is configured to cycle through transmit, receive and communicate operations using a same set of readout electrodes.

11. The ultrasound probe of claim **10**, wherein the circuit board includes a clock which triggers the electronics to cycle through the transmit, the receive and the communicate operations.

12. The ultrasound probe of claim **1**, wherein the probe is configured as an endo-cavitary probe.

13. The ultrasound probe of claim **1**, wherein the probe is configured as a laparoscopic ultrasound probe.

14. A probe, comprising:

an elongate shaft with first and second ends;

a head disposed at one of the first or second ends, wherein the head encloses:

a transducer array; and

a tracking sensor;

a handle disposed at the other of the first or second ends;

a single cable extending from the handle to a single connector of the single cable; and

first and second electrically conductive elements extending inside of the head, the shaft, the handle, the single cable and the single connector, respectively from the transducer array and the tracking sensor to a circuit board disposed inside of the single connector.

15. The ultrasound probe of claim **14**, wherein the circuit board is in electrical communication with a set of pins or sockets of the single connector.

16. The ultrasound probe of claim **15**, wherein the circuit board includes electronics that cycles through receiving a transmit pulse, transferring an electrical signal from the transducer array, and transferring a tracking signal from the tracking sensor, alternately using from the same set of pins or sockets.

17. The ultrasound probe of claim **16**, wherein the electronics gates the signals.

18. The ultrasound probe of claim **16**, wherein the electronics includes circuitry configured to convert an analogic signal into a digital coordinate.

19. The ultrasound probe of claim **14**, wherein the first and second electrically conductive elements are entirely enclosed within the probe.

20. A method, comprising:

transmitting, with a transducer array of a probe, an ultrasound signal in response to a transmit pulse;

receiving, with the transducer array, an echo signal produced in response to an interaction of the ultrasound signal with structure;

generating, with the transducer array, an electrical signal indicative of the receive echo signal;

routing, via a first electrically conductive pathway inside of the probe, the electrical signal from the transducer array to a readout connector of a cable of the probe;

routing, via a second electrically conductive pathway inside of the probe, a tracking signal from a tracking sensor proximate to the transducer array to the same readout connector inside of the same cable of the probe; and

transferring the electrical signal and the tracking signal off the probe through the same readout connector.

* * * * *

专利名称(译)	超声成像系统探针电缆和连接器		
公开(公告)号	US20180289357A1	公开(公告)日	2018-10-11
申请号	US15/479818	申请日	2017-04-05
[标]申请(专利权)人(译)	B-K医疗公司		
申请(专利权)人(译)	B-ķ医疗APS		
当前申请(专利权)人(译)	B-ķ医疗APS		
[标]发明人	JENSEN HENRIK OWEN ROBERT HAROLD ANDERSEN SOREN JUEL BEERS CHRISTOPHER SASADY NIELS CHRISTIAN NYGAARD PER EHRENREICH		
发明人	JENSEN, HENRIK OWEN, ROBERT HAROLD ANDERSEN, SOREN JUEL BEERS, CHRISTOPHER SASADY, NIELS CHRISTIAN NYGAARD, PER EHRENREICH		
IPC分类号	A61B8/00 A61B8/12 A61B8/14 A61B1/313 A61B5/06		
CPC分类号	A61B8/4444 A61B8/12 A61B8/4483 A61B5/062 A61B1/3132 A61B8/461 A61B8/14 A61B5/0215 A61B8/4254		
外部链接	Espacenet USPTO		

摘要(译)

超声探头包括壳体。壳体包括第一端，其内部容纳：换能器阵列和跟踪传感器，以及第二端。壳体还包括在第一和第二端之间延伸的第二部分。第二部分容纳：从换能器阵列穿过第二部分延伸到与第一端相对的第二端的第一导电路径，以及从跟踪传感器穿过第二部分延伸到第二端的第二导电路径。该探针还包括具有物理接口的单个机电连接器，该物理接口被配置为将由第一和第二导电构件承载的信号传输离开探针。探针还包括单根电缆，其将第一和第二导电构件从第二端引导至机电连接器。