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Fibroid ablation positioning device and methods

Abstract

A method of treating a patient with a bioelectrical system is provided. The method may include inserting a probe into a first position in an anatomy of the patient, the system being provided with a plurality of electrodes; energizing a first electrode of the plurality of electrodes with a measurement level of power; determining a complex impedance in the patient's anatomy; determining whether the first position is a desired position of the probe for ablating a predetermined portion of tissue of the patient, based on the complex impedance determined; and energizing one of the plurality of electrodes with an ablation level of power, the ablation level of power being greater than the measurement level of power. An apparatus for performing BIA on a patient is also provided.

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Background/Summary

RELATED APPLICATIONS (1) This application is a continuation of U.S. patent application Ser. No. 15/894,020, filed Feb. 12, 2018, now U.S. Pat. No. 11,298,183, which is a divisional of U.S. patent application Ser. No. 14/484,438, filed on Sep. 12, 2014, which claims the benefit of U.S. Provisional Patent Application No. 61/903,703, filed on Nov. 13, 2013.

(1) The contents of the above applications are incorporated herein by reference in their entirety.

FIELD

(2) The present disclosure relates to an ablation device, and methods for conducting tissue ablation.

BACKGROUND

(3) The statements in this section merely provide background information related to the present disclosure and may or may not constitute prior art.

(4) Ablation needles are currently used to create large areas of necrotic tissue. They can be used for a number of different surgical applications, for example, base of tongue volume reduction or fibroid and/or tumor ablation.

(5) Proper placement of needle electrodes within tumors, while affecting as little adjacent tissue as possible, is desired. Further, an incorrectly placed ablation electrode could result in less than satisfactory necrosis of the tumor and recurrence of the growth. Correct application of energy and detection of endpoint of energy delivery also ensure appropriate amounts of tissue necrosis.

(6) Current state of the art for these ablative techniques require that additional observational devices be used to ensure that the electrode needle is properly placed within the body tissue, detecting the tissue condition throughout the progression of the tissue modification, and detecting when tissue modification is complete. In areas such as atrial and ventricular catheter ablation, the use of fluoroscopy combined with Bioelectrical Analysis have been considered an additional way to ensure that the ablation catheter is correctly placed against heart tissue, rather than sitting in the patient's blood stream to ensure appropriate ablation of the heart tissue. This has been noted in the following documents: U.S. Pat. No. 7,179,258; US 2009/0163904; US 2010/0274239; US 2010/0298823; US 2012/0323237; and U.S. Pat. No. 7,854,740.

(7) Such additional systems require the surgeon to have detailed knowledge of the use of these visualization systems and have access to them at the time of the procedure. Further, additional capital is required for these advanced systems, which detracts from the overall desirability of needle-based ablation technology.

(8) Accordingly, there is a need for an improved system for locating and/or monitoring tissue for which needle necrosis is desired.

SUMMARY

(9) The present disclosure provides an improved ablation needle, and methods for conducting tissue ablation.

(10) Accordingly, pursuant to one aspect of the invention, there is contemplated a method comprising one or more of the following steps: A method of treating a patient comprising: providing a bioelectrical system comprising a probe and a plurality of electrodes; inserting the probe into a position in an anatomy of the patient; energizing a first electrode of the plurality of electrodes with a measurement level of power, the first electrode being coupled with the probe; measuring a bulk tissue property in the patient's anatomy; determining a complex impedance based on the measured bulk tissue property; determining whether the position is a desired position of the probe for ablating a predetermined portion of tissue in the anatomy, based on the complex impedance determined; energizing an ablation electrode of the plurality of electrodes with an ablation level of power when the probe is in the desired position; delivering a source ablation signal from the ablation electrode when the ablation electrode is energized, wherein the ablation electrode is coupled with the probe, the source ablation signal becoming an ablation return signal; delivering a source measurement signal from the first electrode when the first electrode is energized, the source measurement signal becoming a measurement return signal; receiving the measurement return signal through a second electrode of the plurality of electrodes, the second electrode being provided on a measurement return device that is spaced a distance away from the probe; and receiving the ablation return signal through a third electrode of the plurality of electrodes, the third electrode being provided on an ablation return device that is spaced a distance away from the

probe.

(11) The method of treating the patient may be further characterized by one or any combination of the following features: the source ablation signal passes through tissue to the second electrode, the source ablation signal becoming an ablation return signal when the source ablation signal passes through tissue to the second electrode, the method further includes receiving the ablation return signal through the second electrode; and the source ablation signal passes through tissue to the third electrode of the plurality of electrodes, the source ablation signal becoming an ablation return signal when the source ablation signal passes through tissue to the third electrode, the method further includes receiving the ablation return signal through the third electrode.

(12) Accordingly, pursuant to yet another aspect, a method of treating a patient includes one or more of the following steps: providing a bioelectrical system comprising a probe and a plurality of electrodes; inserting the probe into a position in an anatomy of the patient; energizing a first electrode and a second electrode of the plurality of electrodes with a measurement level of power, the first electrode being energized in opposite polarity with respect to the second electrode; determining an impedance in the anatomy; determining whether the position is a desired position of the probe for ablating a predetermined portion of tissue in the anatomy, based on the impedance determined; and energizing two of the plurality of electrodes with an ablation level of power when the probe is in the desired position.

(13) The method of treating the patient may be further characterized by one or any combination of the following features: the method further includes energizing one of the two electrodes in opposite polarity with respect to the other of the two electrodes, the method further includes providing the ablation level of power as greater than the measurement level of power, the step of determining an impedance in the patient's anatomy including determining a complex impedance, providing the two electrodes of the plurality of electrodes as being coupled with the probe, and providing the one of the two electrodes as the first electrode and the other of the two electrodes as the second electrode; the method further includes energizing one of the two electrodes in opposite polarity with respect to the other of the two electrodes, the method further includes providing the ablation level of power as greater than the measurement level of power, the step of determining an impedance in the patient's anatomy including determining a complex impedance, providing the two electrodes of the plurality of electrodes as being coupled with the probe, and providing the two of the plurality of electrodes as being a third electrode and a fourth electrode of the plurality of electrodes; the method further includes providing the first electrode as being coupled with the probe, and delivering a source measurement signal from the first electrode when the first electrode is energized, the source measurement signal becoming a return measurement signal, the method further includes receiving the return measurement signal through the second electrode; the method further includes receiving an ablation return signal through the fourth electrode.

(14) Accordingly, pursuant to yet another aspect, a method of treating a patient with a bioelectrical system includes one or more of the following steps: locating a target object in an anatomy of the patient by performing bioelectrical impedance analysis (BIA) on the anatomy of the patient, including determining a complex impedance in the patient's anatomy; positioning a probe in a desired position for ablating the target object, based on the location of the target object determined by the step of locating the target object; energizing an electrode to an ablation level sufficient to ablate the target object; and providing the electrode as being coupled with the probe.

(15) The method of treating the patient may be further characterized by one or any combination of the following features: the electrode is provided as a first electrode, the method further includes delivering a source ablation signal from the first electrode when the first electrode is energized with the ablation level of power, the method further includes delivering a source measurement signal from the first electrode when first electrode is energized with the measurement level of power, the source measurement signal becoming a measurement return signal, the method further includes receiving the measurement return signal through a second electrode; the method further includes

receiving an ablation return signal through the second electrode; and the method further includes receiving an ablation return signal through a third electrode.
(16) Further aspects, advantages and areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

Description

DRAWINGS
(1) The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.
(2) FIG. **1**A is a side view of a sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(3) FIG. **1**Ai is a schematic diagram illustrating the principles of complex impedance as understood herein, according to the principles of the present disclosure;
(4) FIG. **1**B is a side view of another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(5) FIG. **1**C is a side view of yet another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(6) FIG. **1**D is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(7) FIG. **2**A is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(8) FIG. **2**B is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(9) FIG. **2**C is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(10) FIG. **2**D is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(11) FIG. **2**E is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(12) FIG. **2**F is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(13) FIG. **2**G is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(14) FIG. **3**A is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(15) FIG. **3**B is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(16) FIG. **3**C is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(17) FIG. **3**D is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(18) FIG. **3**E is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(19) FIG. **3**F is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(20) FIG. **3**G is a side view of still another sensing and ablation system having a single probe in the

form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(21) FIG. **3**H is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(22) FIG. **3**I is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(23) FIG. **3**J is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(24) FIG. **3**K is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(25) FIG. **3**L is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(26) FIG. **3**M is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(27) FIG. **3**N is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(28) FIG. **3**O is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(29) FIG. **3**P is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(30) FIG. **3**Q is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(31) FIG. **3**R is a side view of still another sensing and ablation system having a single probe in the form of a monopolar ablation needle, in accordance with the principles of the present disclosure;
(32) FIG. **4**A is a side view of a sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(33) FIG. **4**B is a side view of another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(34) FIG. **4**C is a side view of yet another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(35) FIG. **4**D is a side view of still another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(36) FIG. **4**E is a side view of still another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(37) FIG. **4**F is a side view of still another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(38) FIG. **4**G is a side view of still another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(39) FIG. **4**H is a side view of still another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(40) FIG. **4**I is a side view of still another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(41) FIG. **4**J is a side view of still another sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(42) FIG. **5** is a table showing additional variants of a sensing and ablation system having two probes in the form of monopolar ablation needles, in accordance with the principles of the present disclosure;
(43) FIG. **6**A is a side view of a sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(44) FIG. **6**B is a side view of another sensing and ablation system having a single probe in the

form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(45) FIG. **6**C is a side view of yet another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(46) FIG. **6**D is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(47) FIG. **6**E is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(48) FIG. **6**F is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(49) FIG. **6**G is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(50) FIG. **6**H is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(51) FIG. **6**I is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(52) FIG. **6**J is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(53) FIG. **6**K is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(54) FIG. **6**L is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(55) FIG. **6**M is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(56) FIG. **6**N is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(57) FIG. **6**O is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(58) FIG. **6**P is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(59) FIG. **6**Q is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(60) FIG. **6**R is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(61) FIG. **6**S is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(62) FIG. **6**T is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(63) FIG. **6**U is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(64) FIG. **7**A is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(65) FIG. **7**B is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(66) FIG. **7**C is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(67) FIG. **7**D is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(68) FIG. **7**E is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(69) FIG. **7**F is a side view of still another sensing and ablation system having a single probe in the

form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(70) FIG. **7**G is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(71) FIG. **7**H is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(72) FIG. **7**I is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(73) FIG. **7**J is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(74) FIG. **7**K is a side view of still another sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(75) FIG. **8**A is a table showing additional variants of a sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(76) FIG. **8**B is a table showing more additional variants of a sensing and ablation system having a single probe in the form of a bipolar ablation needle, in accordance with the principles of the present disclosure;
(77) FIG. **9**A is a side view of a sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(78) FIG. **9**B is a side view of another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(79) FIG. **9**C is a side view of yet another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(80) FIG. **9**D is a side view of still another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(81) FIG. **9**E is a side view of still another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(82) FIG. **9**F is a side view of still another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(83) FIG. **9**G is a side view of still another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(84) FIG. **9**H is a side view of still another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(85) FIG. **9**I is a side view of still another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(86) FIG. **9**J is a side view of still another sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(87) FIG. **10**A is a table showing additional variants of a sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(88) FIG. **10**B is a table showing more additional variants of a sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure;
(89) FIG. **10**C is a table showing even more additional variants of a sensing and ablation system having two probes in the form of bipolar ablation needles, in accordance with the principles of the present disclosure; and
(90) FIG. **11** is a block diagram illustrating a method of treating a patient with a bioelectrical system, in accordance with the principles of the present disclosure.

DETAILED DESCRIPTION

(91) The following description is merely exemplary in nature and is not intended to limit the

present disclosure, application, or uses.

(92) The present disclosure provides a tissue ablation device, system, and method. Various forms of a needle ablation electrode and system are disclosed. Each system has a sensing circuit and an ablation circuit. The sensing circuit is configured to send a measurement signal into a patient's tissue and to measure a bulk tissue property and/or determine impedance, in order to decide whether the probe has been properly placed. Once the probe is properly placed, the tissue can be ablated with the ablation circuit.

(93) For example, with reference to FIG. **1**A, a sensing and ablation system for treating a patient through bioelectricity is illustrated and generally designated at **20**A. The system **20**A includes a probe **22** in the form of a needle having a pointed distal end **24**. The probe **22** is configured to be inserted into the patient's anatomy for ablation of bodily tissue in the patient's anatomy. The probe **22** may be rigid, malleable, or selectively deflectable.

(94) The probe **22** is itself a monopolar ablation electrode that is configured to emit an electric signal for ablation of nearby tissue. Accordingly, the probe **22** is typically placed near tissue for which necrosis or other ablation is desired. As used herein (unless otherwise described), the term “monopolar” denotes an apparatus bearing an electrode configured to emit an electric signal to pass to a return electrode, wherein the return electrode is located remotely from, or spaced a distance away from the apparatus. As used herein, unless otherwise described, “bipolar” refers to an ablation circuit located on a probe apparatus, wherein each of the electrodes of the bipolar circuit is coupled with the probe apparatus. In the “bipolar” circuit, a signal is sent between two electrodes that are both coupled to a probe device and both are inserted into the patient on the device.

(95) The probe **22** has a first electrode **26**A attached to the distal end **24** of the probe **22**. The first electrode **26**A is an active electrode that is coupled with and energized by an electrode energy source. When energized, the power is applied to the electrode. A skin patch electrode **28** in this example is located on the patient's skin (not shown). The first electrode **26**A and the patch electrode **28** make up a sensing circuit. The patch electrode **28** is a neutral electrode that is not configured to be energized by an energy source. In other words, the patch electrode **28** is grounded, or electrically tied to earth.

(96) The patch electrode **28** is configured to receive a measurement signal from the first electrode **26**A and conduct data from the measurement signal to determine a complex impedance in the patient's anatomy while the first electrode **26**A is energized. For example, the magnitude of the impedance may be calculated from voltage drop and current. For example, the magnitude of the impedance (or the resistance) is equal to the applied voltage drop divided by the current. Reactance may be calculated based on the frequency and capacitance. The phase angle may be determined based on the relationship between the resistance and the reactance. Different tissues have different electrical impedances and resistances, and as such, a user can know whether the probe **22** is appropriately placed, based on the data collected from the sensing circuit.

(97) In one variation, an impedance, such as a complex impedance is determined based on the bulk tissue property or properties measured, such as resistance, reactance, capacitance, and/or inductance. A complex impedance includes resistance and reactance. For example, see FIG. **1**Ai. FIG. **1**Ai illustrates the complex nature of the complex impedance Z. The complex impedance Z is a measure of the overall opposition of a circuit to current, or how much the circuit impedes the flow of current. The complex impedance Z takes into account the effects of capacitance and inductance. The effects of capacitance and inductance vary with the frequency of the current passing through the circuit, and as such, complex impedance Z varies with frequency. The complex impedance Z has a constant component, which may be referred to as Resistance R, or simple impedance. The complex impedance Z also has a Reactance X component, which is the part that varies with frequency due to capacitance and inductance. Total Reactance X is the difference between Capacitive Reactance X.sub.C and Inductive Reactance X.sub.L. The capacitance and inductance cause a phase shift between the current and voltage. Thus, to determine the complex

impedance Z, the simple impedance, or resistance, R and the Reactance X must be added as vectors at right angles, as illustrated in FIG. **1**Ai. Accordingly, Complex Impedance Z equals the square root of the sum of the Resistance R squared and the Reactance X squared, or Z=√{square root over (R.sup.2+X.sup.2)}.

(98) The sensing and ablation system **20**A also includes an ablation circuit, made up of the probe **22** itself and the patch electrode **28**, or another electrode. In the alternative, the ablation circuit may also include the first electrode **26**A. The ablation circuit is configured to deliver a source ablation signal from the probe **22** (or from the first electrode **26**, located on the probe **22**). The probe **22** (or first electrode **26**) is configured to deliver the source ablation signal to the patient's tissue, and the source ablation signal is configured to travel through the tissue and become an ablation return signal. The ablation circuit is configured to receive the ablation return signal on the patch electrode **28** (or another electrode) that is disposed a distance away from the probe **22**. Thus, the patch electrode **28** receives the ablation return signal as the tissue is ablated by the ablation circuit. The power of the ablation signal is higher than the power of the measurement signal. Accordingly, the measurement signal preferably does not alter the tissue; however, the ablation signal preferably causes necrosis of the tissue.

(99) Referring now to FIG. **1**B, a variation from the sensing and ablation system illustrated in FIG. **1**A at reference number **20**A is now illustrated at reference number **20**B. The sensing and ablation system **20**B shown in FIG. **1**B may be the same as the sensing and ablation system **20**A illustrated in FIG. **1**A, except that the first electrode **26**B is illustrated behind the needle portion **30** of the probe **22**. In other words, the first electrode **26**B is located proximally of the needle portion **30**, or closer to a proximal end **32** of the probe **22** than the needle portion **30**.

(100) Referring now to FIG. **1**C, a variation from the sensing and ablation system illustrated in FIGS. **1**A and **1**B at reference numbers **20**A and **20**B is now illustrated at reference number **20**C. The sensing and ablation system **20**C shown in FIG. **1**C may be the same as the sensing and ablation system **20**A or **20**B illustrated in FIG. **1**A or **1**B, except that the first electrode **26**C is illustrated on the side **29** of the needle portion **30** of the probe **22**.

(101) Referring now to FIG. **1**D, a variation from the sensing and ablation system illustrated in FIGS. **1**A, **1**B, and **1**C at reference numbers **20**A, **20**B, and **20**C is now illustrated at reference number **20**D. The sensing and ablation system **20**D shown in FIG. **1**D may be the same as the sensing and ablation system **20**A, **20**B, or **20**C illustrated in FIG. **1**A, **1**B, or **1**C, except that the first electrode **26**D is illustrated as the needle portion **30** of the probe itself **22**.

(102) In another variation, a sensing and ablation system is illustrated in FIG. **2**A and generally indicated reference number **120**A. In this variation, both a first electrode **126**A and a second electrode **128**A are located on a probe **122**, which is in the form of a needle having a pointed distal end **124**. Like the probe **22** of FIGS. **1**A-**1**D, the probe **122** of FIG. **2**A is configured to be inserted into the patient's anatomy for ablation of bodily tissue in the patient's anatomy, and the probe **122** itself is a monopolar ablation electrode.

(103) The first and second electrodes **126**A, **128**A are each attached to the side **129** of the needle portion **130** of the probe **122**, and the first and second electrodes **126**A, **128**A are spaced a distance apart from each other along the length of the side **129** of the needle portion **130**. The first electrode **126**A and the second electrode **128**A make up a sensing circuit. One of the first and second electrodes **126**A, **128**A is an active electrode that is coupled with and energized by an electrode energy source. The other of the first and second electrodes **126**A, **128**A is a measurement return electrode, which is a neutral electrode that is not configured to be energized by an energy source. The measurement return electrode is configured to provide data to the system based on the measurement signal, for determining a complex impedance in the patient's anatomy while the active electrode is energized, as explained above. Thus, the measurement signal is passed between the first and second electrodes **126**A, **128**A.

(104) The sensing and ablation system **120**A also includes an ablation circuit, made up of the probe

122 (or one of the electrodes **126**A, **128**A) and another electrode, such as a skin patch electrode (not shown). The ablation circuit is configured to deliver a source ablation signal from the probe **122** or one of the first and second electrodes **126**A, **128**A, which is the ablation active electrode. The ablation active electrode is configured to deliver the source ablation signal to the patient's tissue, and the source ablation signal is configured to travel through the tissue and become an ablation return signal. The ablation circuit is configured to receive the ablation return signal through the ablation return electrode, which may be a skin patch electrode (not shown), by way of example. Although not shown in FIG. **2**A, skin patches **28** are schematically illustrated in FIGS. **1**A-**1**D, which may be used in conjunction with the system **120**A of FIG. **2**A. A skin patch may be attached externally to a patient's skin, by way of example. Thus, the ablation return electrode receives the ablation return signal as the tissue is ablated by the ablation circuit.

(105) Referring now to FIG. **2**B, a variation from the sensing and ablation system illustrated in FIG. **2**A at reference number **120**A is now illustrated at reference number **120**B. The sensing and ablation system **120**B shown in FIG. **2**B may be the same as the sensing and ablation system **120**A illustrated in FIG. **2**A, except that the second electrode **128**B is illustrated behind the needle portion **130** of the probe **122**. In other words, the second electrode **128**B is located proximally of the needle portion **130**, or closer to a proximal end **132** of the probe **122** than the needle portion **130** is to the proximal end **132**.

(106) Referring now to FIG. **2**C, a variation from the sensing and ablation system illustrated in FIGS. **2**A and **2**B at reference numbers **120**A and **120**B is now illustrated at reference number **120**C. The sensing and ablation system **120**C shown in FIG. **2**C may be the same as the sensing and ablation system **120**A or **120**B illustrated in FIG. **2**A or **2**B, except that the second electrode **128**C is illustrated on the distal end **124** of the needle portion **130** of the probe **122**.

(107) Referring now to FIG. **2**D, a variation from the sensing and ablation system illustrated in FIGS. **2**A, **2**B, and **2**C at reference numbers **120**A, **120**B, and **120**C is now illustrated at reference number **120**D. The sensing and ablation system **120**D shown in FIG. **2**D may be the same as the sensing and ablation system **120**A, **120**B, or **120**C illustrated in FIG. **2**A, **2**B, or **2**C, except that the second electrode **128**D is illustrated as the needle portion **130** of the probe itself **122**.

(108) Referring now to FIG. **2**E, a variation from the sensing and ablation system illustrated in FIGS. **2**A-**2**D at reference numbers **120**A-**120**D is now illustrated at reference number **120**E. The sensing and ablation system **120**E shown in FIG. **2**E may be the same as the sensing and ablation system **120**A-**120**D illustrated in FIGS. **2**A-**2**D, except that the second electrode **128**E is illustrated on the distal end **124** of the needle portion **130** of the probe **122** and the first electrode **126**E is located proximally of the needle portion **130**, or closer to a proximal end **132** of the probe **122** than the needle portion **130** is to the proximal end **132**.

(109) Referring now to FIG. **2**F, a variation from the sensing and ablation system illustrated in FIGS. **2**A-**2**E at reference numbers **120**A-**120**E is now illustrated at reference number **120**F. The sensing and ablation system **120**F shown in FIG. **2**F may be the same as the sensing and ablation system **120**A-**120**E illustrated in FIGS. **2**A-**2**E, except that the first electrode **126**F is located proximally of the needle portion **130**, or closer to a proximal end **132** of the probe **122** than the needle portion **130** is to the proximal end **132**, and the second electrode **128**F is illustrated as the needle portion **130** of the probe itself **122**.

(110) Referring now to FIG. **2**G, a variation from the sensing and ablation system illustrated in FIGS. **2**A-**2**F at reference numbers **120**A-**120**F is now illustrated at reference number **120**G. The sensing and ablation system **120**G shown in FIG. **2**G may be the same as the sensing and ablation system **120**A-**120**F illustrated in FIGS. **2**A-**2**F, except that the first electrode **126**G is illustrated as the needle portion **130** of the probe itself **122** and the second electrode **128**G is illustrated on the distal end **124** of the needle portion **130** of the probe **122**.

(111) FIGS. **1**A-**2**G illustrated a sensing and ablation system that had only two electrodes for the sensing circuit. Referring now to FIG. **3**A, a sensing and ablation system is illustrated and

generally designated reference number **220**A. In this variation, both a first electrode **226**A and a second electrode **228**A are located on a probe **222**, which is in the form of a needle having a pointed distal end **224**. Similar to the probes **22**, **122** described above, the probe **222** is an electrode for an ablation circuit. In addition to the first electrode **226**A, the second electrode **228**A, and the probe **222** as an electrode, a third sensing electrode **234**A is also provided on the probe **222**. Like the probes **22**, **122** of FIGS. **1**A-**2**G, the probe **222** of FIG. **3**A is configured to be inserted into the patient's anatomy for ablation of bodily tissue in the patient's anatomy.

(112) The first, second, and third electrodes **226**A, **228**A, **234**A are each attached to the side **229** of the needle portion **230** of the probe **222**, and each of the first, second, and third electrodes **226**A, **228**A, **234**A are spaced a distance apart from each other along the length of the side **229** of the needle portion **230**. Two of the first electrode **226**A, the second electrode **228**A, and the third electrode **234**A make up a sensing circuit. Thus, one of the first, second, and third electrodes **226**A, **228**A, **234**A is an active electrode that is coupled with and energized by an electrode energy source. Another of the first electrode **226**A, the second electrode **228**A, and the third electrode **234**A is a neutral electrode that is not configured to be energized by an energy source; the neutral electrode is configured to provide data based on the measurement signal, for determining a complex impedance in the patient's anatomy while the active electrode is energized, as explained above. (In some variations, an active electrode may also serve as a return electrode). Thus, the measurement signal is passed between two of the first, second, and third electrodes **226**A, **228**A, **234**A.

(113) The sensing and ablation system **220**A also includes an ablation circuit, made up of the probe **222** itself (or one of the first, second, or third electrodes **226**A, **228**A, **234**A) and a return electrode (not shown), such as the skin patch electrodes **28** previously described. The ablation circuit is configured to deliver a source ablation signal from an ablation source electrode. The ablation source electrode is configured to deliver the source ablation signal to the patient's tissue, and the source ablation signal is configured to travel through the tissue and become an ablation return signal. The ablation circuit is configured to receive the ablation return signal through an ablation return electrode (not shown). Thus, the ablation return electrode receives the ablation return signal as the tissue is ablated by the ablation circuit.

(114) With the variation of FIG. **3**A, the measurement source electrode and the ablation source electrode may be the same electrode of the first, second, and third electrodes **226**A, **228**A, **234**A, but they may also be two different electrodes of the first, second, and third electrodes **226**A, **228**A, **234**A and the probe **222**. Similarly, the measurement return electrode and the ablation return electrode may be the same of the first, second, and third electrodes **226**A, **228**A, **234**A, or the ablation return electrode may be another electrode (not shown), for example, a skin patch electrode such as illustrated in FIG. **3**H, **3**J, **3**K, or **3**M-**3**R.

(115) Since the measurement circuit has three electrodes **226**A, **228**A, **234**A, two at a time may be used to sense the voltage drop in different areas, for a more fine-tuned estimate of the position of the probe **222**. The measurement circuit may switch between which two of the sensing electrodes **226**A, **228**A, **234**A are used.

(116) Referring now to FIG. **3**B, a variation from the sensing and ablation system illustrated in FIG. **3**A at reference number **120**A is now illustrated at reference number **220**B. The sensing and ablation system **220**B shown in FIG. **3**B may be the same as the sensing and ablation system **220**A illustrated in FIG. **3**A, except that the first electrode **226**B is illustrated behind the needle portion **230** of the probe **222**. In other words, the first electrode **226**B is located proximally of the needle portion **230**, or closer to a proximal end **232** of the probe **222** than the needle portion **230** is to the proximal end **232**. The second and third electrodes **228**B, **234**B are disposed on the side **229** of the probe **222**.

(117) Referring now to FIG. **3**C, a variation from the sensing and ablation system illustrated in FIGS. **3**A and **3**B at reference numbers **220**A and **220**B is now illustrated at reference number **220**C. The sensing and ablation system **220**C shown in FIG. **3**C may be the same as the sensing and

ablation system **220**A or **220**B illustrated in FIG. **3**A or **3**B, except that the first electrode **226**C is illustrated on the distal end **224** of the needle portion **230** of the probe **222**. The second and third electrodes **228**C, **234**C are disposed on the side **229** of the probe **222**.

(118) Referring now to FIG. **3**D, a variation from the sensing and ablation system illustrated in FIGS. **3**A, **3**B, and **3**C at reference numbers **220**A, **220**B, and **220**C is now illustrated at reference number **220**D. The sensing and ablation system **220**D shown in FIG. **3**D may be the same as the sensing and ablation system **220**A, **220**B, or **220**C illustrated in FIG. **3**A, **3**B, or **3**C, except that the first electrode **226**D is illustrated as the needle portion **230** of the probe itself **222**. The second and third electrodes **228**D, **234**D are disposed on the side **229** of the probe **222**.

(119) Referring now to FIG. **3**E, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**D at reference numbers **220**A-**220**D is now illustrated at reference number **220**E. The sensing and ablation system **220**E shown in FIG. **3**E may be the same as the sensing and ablation system **220**A-**220**D illustrated in FIGS. **3**A-**3**D, except that the first electrode **226**E is a patch electrode located a distance away from the probe **222**. The second and third electrodes **228**E, **234**E are disposed on the side **229** of the probe **222**.

(120) Referring now to FIG. **3**F, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**E at reference numbers **220**A-**220**E is now illustrated at reference number **220**F. The sensing and ablation system **220**F shown in FIG. **3**F may be the same as the sensing and ablation system **220**A-**220**E illustrated in FIGS. **3**A-**3**E, except that the first electrode **226**F is located proximally of the needle portion **230**, or closer to a proximal end **232** of the probe **222** than the needle portion **230** is to the proximal end **232**, and the third electrode **234**F is located on the distal end **224** of the probe **222**. The second electrode **228**F is disposed on the side **229** of the probe **222**.

(121) Referring now to FIG. **3**G, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**F at reference numbers **220**A-**220**F is now illustrated at reference number **220**G. The sensing and ablation system **220**G shown in FIG. **3**G may be the same as the sensing and ablation system **220**A-**220**F illustrated in FIGS. **3**A-**3**F, except that the first electrode **226**G is located proximally of the needle portion **230**, or closer to a proximal end **232** of the probe **222** than the needle portion **230** is to the proximal end **232**, the second electrode **228**G is disposed on the side **229** of the probe **222**, and the third electrode **234**G is the needle **230** itself.

(122) Referring now to FIG. **3**H, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**G at reference numbers **220**A-**220**G is now illustrated at reference number **220**H. The sensing and ablation system **220**H shown in FIG. **3**H may be the same as the sensing and ablation system **220**A-**220**G illustrated in FIGS. **3**A-**3**G, except that the first electrode **226**H is located proximally of the needle portion **230**, or closer to a proximal end **232** of the probe **222** than the needle portion **230** is to the proximal end **232**, the second electrode **228**H is disposed on the side **229** of the probe **222**, and the third electrode **234**H is a patch electrode disposed a distance away from the distal end **224** of the probe **222**.

(123) Referring now to FIG. **3**I, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**H at reference numbers **220**A-**220**H is now illustrated at reference number **220**I. The sensing and ablation system **220**I shown in FIG. **3**I may be the same as the sensing and ablation system **220**A-**220**H illustrated in FIGS. **3**A-**3**H, except that the first electrode **226**I is the needle portion **230** itself, the second electrode **228**I is disposed on the side **229** of the probe **222**, and the third electrode **234**I is disposed on the distal end **224** of the probe **222**.

(124) Referring now to FIG. **3**J, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**I at reference numbers **220**A-**220**I is now illustrated at reference number **220**J. The sensing and ablation system **220**J shown in FIG. **3**J may be the same as the sensing and ablation system **220**A-**220**I illustrated in FIGS. **3**A-**3**I, except that the first electrode **226**J is disposed at the distal end **224** of the probe **222**, the second electrode **228**J is disposed on the side **229** of the probe **222**, and the third electrode **234**J is a patch electrode that is disposed a distance away from the probe **222**.

(125) Referring now to FIG. **3**K, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**J at reference numbers **220**A-**220**J is now illustrated at reference number **220**K. The sensing and ablation system **220**K shown in FIG. **3**K may be the same as the sensing and ablation system **220**A-**220**J illustrated in FIGS. **3**A-**3**J, except that the first electrode **226**K is a patch electrode disposed a distance away from the probe **222**, the second electrode **228**K is disposed on the side **229** of the probe **222**, and the third electrode **234**K is a patch electrode that is disposed a distance away from the probe **222**.
(126) Referring now to FIG. **3**L, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**K at reference numbers **220**A-**220**K is now illustrated at reference number **220**L. The sensing and ablation system **220**L shown in FIG. **3**L may be the same as the sensing and ablation system **220**A-**220**K illustrated in FIGS. **3**A-**3**K, except that the first electrode **226**L is disposed proximally of the needle portion **230** of the probe **222**, or closer to the proximal end **232** than the needle portion **230** is to the proximal end **232**, the second electrode **228**L is the needle portion **230** itself, and the third electrode **234**L is disposed at the distal end **224** of the probe **222**.
(127) Referring now to FIG. **3**M, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**L at reference numbers **220**A-**220**L is now illustrated at reference number **220**M. The sensing and ablation system **220**M shown in FIG. **3**M may be the same as the sensing and ablation system **220**A-**220**L illustrated in FIGS. **3**A-**3**L, except that the first electrode **226**M is disposed proximally of the needle portion **230** of the probe **222**, or closer to the proximal **232** than the needle portion **230** is to the proximal end **232**, the second electrode **228**M is disposed at the distal end **224** of the probe **222**, and the third electrode **234**M is a patch electrode that is disposed a distance away from the probe **222**.
(128) Referring now to FIG. **3**N, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**M at reference numbers **220**A-**220**M is now illustrated at reference number **220**N. The sensing and ablation system **220**N shown in FIG. **3**N may be the same as the sensing and ablation system **220**A-**220**M illustrated in FIGS. **3**A-**3**M, except that the first electrode **226**N is disposed proximally of the needle portion **230**, or closer to the proximal end **232** than the needle portion **230** is to the proximal end **232**, and the second and third electrodes **228**N, **234**N are patch electrodes that are disposed a distance away from the probe **222** and from each other.
(129) Referring now to FIG. **3**O, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**N at reference numbers **220**A-**220**N is now illustrated at reference number **220**O. The sensing and ablation system **220**O shown in FIG. **3**O may be the same as the sensing and ablation system **220**A-**220**N illustrated in FIGS. **3**A-**3**N, except that the first electrode **226**O is the needle portion **230** itself, the second electrode **228**O is disposed at the distal end **224** of the probe **220**O, and the third electrode **234**O is a patch electrode that is disposed a distance away from the probe **222**.
(130) Referring now to FIG. **3**P, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**O at reference numbers **220**A-**220**O is now illustrated at reference number **220**P. The sensing and ablation system **220**P shown in FIG. **3**P may be the same as the sensing and ablation system **220**A-**220**O illustrated in FIGS. **3**A-**3**O, except that the first electrode **226**P is disposed at the distal end **224** of the probe **222**, and the second and third electrodes **228**P, **234**P are patch electrodes that are disposed a distance away from the probe **222** and from each other.
(131) Referring now to FIG. **3**Q, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**P at reference numbers **220**A-**220**P is now illustrated at reference number **220**Q. The sensing and ablation system **220**Q shown in FIG. **3**Q may be the same as the sensing and ablation system **220**A-**220**P illustrated in FIGS. **3**A-**3**P, except that the first electrode **226**Q is the needle portion **230** itself, and the second and third electrodes **228**Q, **234**Q are patch electrodes that are disposed a distance away from the probe **222** and from each other.
(132) Referring now to FIG. **3**R, a variation from the sensing and ablation system illustrated in FIGS. **3**A-**3**Q at reference numbers **220**A-**220**Q is now illustrated at reference number **220**R. The

sensing and ablation system **220**R shown in FIG. **3**R may be the same as the sensing and ablation system **220**A-**220**Q illustrated in FIGS. **3**A-**3**Q, except that all three electrodes **226**R, **228**R, **234**R are patch electrodes that are disposed a distance away from the probe **222** and from each other. None of the electrodes **226**R, **228**R, **234**R is coupled with the probe **222**.
(133) In yet another variation of a sensing and ablation system within the present disclosure is system involving more than one probe. For example, FIGS. **4**A-**4**J illustrate several embodiments of a sensing and ablation system **320**A-**320**J having multiples needles. In FIG. **4**A, a sensing and ablation system is illustrated in FIG. **4**A and generally indicated reference number **320**A. In this variation, a first electrode **326**A is located on a first probe **322**, and a second electrode **328**A is located on a second probe **336**. The first and the second probes **322**, **336** are in the form of needles having pointed distal ends **324**, wherein the probes **322**, **336** themselves are ablation electrodes, as described above. Like the probes **22**, **122**, **222** hereinbefore described, the probes **322**, **336** of FIG. **4**A are configured to be inserted into the patient's anatomy for ablation of bodily tissue in the patient's anatomy. The first and second electrodes **326**A, **328**A are each disposed at the distal ends **324** of the probes **322**, **336**.
(134) The first electrode **326**A and the second electrode **328**A make up a sensing circuit. One of the first and second electrodes **326**A, **328**A is an active electrode that is coupled with and energized by an electrode energy source. The other of the first and second electrodes **326**A, **328**A is a measurement return electrode, which is a neutral electrode that is not configured to be energized by an energy source. (In some variations, an active electrode may also serve as the return electrode). The measurement return electrode is configured to provide data based on the measurement signal, for determining a complex impedance in the patient's anatomy while the active electrode is energized, as explained above. Thus, the measurement signal is passed between the first and second electrodes **326**A, **328**A.
(135) The sensing and ablation system **320**A also includes an ablation circuit, made up of at least one of the probes **322**, **336** themselves as the electrode, or one of the first electrode **326**A and the second electrode **328**A. The ablation circuit is configured to deliver a source ablation signal from at least one of the probes **322**, **336** or the first and second electrodes **326**A, **328**A, which is the ablation active electrode. The ablation active electrode is configured to deliver the source ablation signal to the patient's tissue, and the source ablation signal is configured to travel through the tissue and become an ablation return signal. The ablation circuit is configured to receive the ablation return signal through the ablation return electrode, which may be one of the probes **322**, **336**, one of the first and second electrodes **326**A, **328**A, or a skin patch electrode (not shown in FIG. **4**A). Thus, the ablation return electrode receives the ablation return signal as the tissue is ablated by the ablation circuit.
(136) Referring now to FIG. **4**B, a variation from the sensing and ablation system illustrated in FIG. **4**A at reference number **320**A is now illustrated at reference number **320**B. The sensing and ablation system **320**B shown in FIG. **4**B may be the same as the sensing and ablation system **320**A illustrated in FIG. **4**A, except that the second electrode **328**B is illustrated behind the needle portion **330** of the probe **322**. In other words, the second electrode **328**B is located proximally of the needle portion **330**, or closer to a proximal end **332** of the probe **322** than the needle portion **330** is to the proximal end **332**.
(137) Referring now to FIG. **4**C, a variation from the sensing and ablation system illustrated in FIGS. **4**A and **4**B at reference numbers **320**A and **320**B is now illustrated at reference number **320**C. The sensing and ablation system **320**C shown in FIG. **4**C may be the same as the sensing and ablation system **320**A or **320**B illustrated in FIG. **4**A or **4**B, except that the second electrode **328**C is the needle portion **330** itself of the second probe **336**.
(138) Referring now to FIG. **4**D, a variation from the sensing and ablation system illustrated in FIGS. **4**A, **4**B, and **4**C at reference numbers **320**A, **320**B, and **320**C is now illustrated at reference number **320**D. The sensing and ablation system **320**D shown in FIG. **4**D may be the same as the

sensing and ablation system **320**A, **320**B, or **320**C illustrated in FIG. **4**A, **4**B, or **4**C, except that both the first and second electrodes **326**D, **328**D are illustrated as the needle portions **330** of the probes **322**, **336** themselves. In other words, the first electrode **326**D is the needle portion **330** of the first probe **322**, and the second electrode **328**D is the needle portion **330** of the second probe **336**.

(139) Referring now to FIG. **4**E, a variation from the sensing and ablation system illustrated in FIGS. **4**A-**4**D at reference numbers **320**A-**320**D is now illustrated at reference number **320**E. The sensing and ablation system **320**E shown in FIG. **4**E may be the same as the sensing and ablation system **320**A-**320**D illustrated in FIGS. **4**A-**4**D, except that the first electrode **326**E is disposed on the side **329** of the needle portion **330** of the first probe **322**, and the second electrode **328**E is disposed on the side **329** of the needle portion **320** of the second probe **336**.

(140) Referring now to FIG. **4**F, a variation from the sensing and ablation system illustrated in FIGS. **4**A-**4**E at reference numbers **320**A-**320**E is now illustrated at reference number **320**F. The sensing and ablation system **320**F shown in FIG. **4**F may be the same as the sensing and ablation system **320**A-**320**E illustrated in FIGS. **4**A-**4**E, except that the first electrode **326**F is disposed on the side **329** of the needle portion **330** of the first probe **322**, while the second electrode **328**F is a skin patch electrode disposed a distance away from the first and second probes **322**, **336**.

(141) Referring now to FIG. **4**G, a variation from the sensing and ablation system illustrated in FIGS. **4**A-**4**F at reference numbers **320**A-**320**F is now illustrated at reference number **320**G. The sensing and ablation system **320**G shown in FIG. **4**G may be the same as the sensing and ablation system **320**A-**320**F illustrated in FIGS. **4**A-**4**F, except that both the first and second electrodes **326**G, **328**G are skin patch electrodes that are disposed a distance away from the first and second probes **322**, **336** and each other.

(142) Referring now to FIG. **4**H, a variation from the sensing and ablation system illustrated in FIGS. **4**A-**4**G at reference numbers **320**A-**320**G is now illustrated at reference number **320**H. The sensing and ablation system **320**H shown in FIG. **4**H may be the same as the sensing and ablation system **320**A-**320**G illustrated in FIGS. **4**A-**4**G, except that both the first and second electrodes **326**H, **328**H are coupled with the first probe **322**. The first electrode **326**H is disposed proximally of the needle portion **330**, such that the first electrode **326**H is disposed closer to the proximal end **332** of the first probe **322** than the needle portion **330** is to the proximal end **332**. The second electrode **328**H is attached to the distal end **324** of the first probe **322**.

(143) Referring now to FIG. **4**I, a variation from the sensing and ablation system illustrated in FIGS. **4**A-**4**H at reference numbers **320**A-**320**H is now illustrated at reference number **320**I. The sensing and ablation system **320**I shown in FIG. **4**I may be the same as the sensing and ablation system **320**A-**320**H illustrated in FIGS. **4**A-**4**H, except that both the first and second electrodes **326**I, **328**I are coupled with the first probe **322**, wherein the first electrode **326**I is the needle portion **330** itself and the second electrode **328**I is attached to the distal end **324** of the first probe **322**.

(144) Referring now to FIG. **4**J, a variation from the sensing and ablation system illustrated in FIGS. **4**A-**4**I at reference numbers **320**A-**320**I is now illustrated at reference number **320**J. The sensing and ablation system **320**J shown in FIG. **4**J may be the same as the sensing and ablation system **320**A-**320**I illustrated in FIGS. **4**A-**4**I, except that the first electrode **326**J is the needle portion **330** itself of the first probe **322**, and the second electrode **328**J is disposed proximally of the needle portion **330** of the second probe **336**, such that the second electrode **326**J is disposed closer to the proximal end **332** of the second probe **336** than the needle portion **330** is to the proximal end **322**.

(145) Further variations of a two-probe system having first and second electrodes are illustrated in FIG. **5**.

(146) Referring now to FIG. **6**A, a sensing and ablation system comprising four electrodes is illustrated and generally designated at **420**A. In the embodiment of FIG. **6**A, a pair of ablation

potential electrodes **438**A, **440**A are disposed on a probe **422**, which is in the form of a needle having a pointed distal end **424**. Accordingly, the probe **422** is a bipolar ablation device. A non-energized portion **442** separates the pair of ablation potential electrodes **438**A, **440**A. Like the probes **22**, **122**, **222**, **322** of FIGS. **1**A-**4**J, the probe **422** of FIG. **6**A is configured to be inserted into the patient's anatomy for ablation of bodily tissue in the patient's anatomy.

(147) The pair of ablation electrodes **438**A, **440**A forms an ablation circuit. The first ablation electrode **438**A of the pair of ablation electrodes **438**A, **440**A delivers a source ablation signal, which travels through tissue near the probe **422** and turns into an ablation return signal, which is received by the second ablation electrode **440**A. Likewise, the second ablation electrode **440**A delivers a source ablation signal, which travels through tissue near the probe **422** and turns into an ablation return signal, which is received by the first ablation electrode **438**A. Thus, each of the ablation electrodes **438**A, **440**A sends an ablation signal into the patient's tissue to ablate the tissue. In the alternative, a single one of the pair of ablation electrodes **438**A, **440**A may send the ablation signal while the other of the pair of ablation electrodes **438**A, **440**A receives the ablation return signal. Another electrode may also serve as the return electrode.

(148) A first skin patch electrode **444**A and a second skin patch electrode **446**A make up a sensing circuit. One or both of the patch electrodes **444**A, **446**A sends out a sensing signal that is received by the other of the patch electrodes **444**A, **446**A. Thus, at least one of the patch electrodes **444**A, **446**A is an active electrode that is coupled with and energized by an electrode energy source. The receiving patch electrode(s) **444**A, **446**A is configured to provide data based on the measurement signal, for determining a complex impedance in the patient's anatomy while the active electrode is energized, as explained above. Thus, the measurement signal is passed between the patch electrodes **444**A, **446**A.

(149) With the variation of FIG. **6**A, the measurement source electrode and the ablation source electrode and the measurement return electrode and ablation return electrode may be different electrodes or the same electrodes. For example, although the pair of electrodes **438**A, **440**A is described as forming the ablation circuit and the pair of electrodes **444**A, **446**A is described as forming the measurement circuit, any of the electrodes **438**A, **440**A, **444**A, **446**A may form a part of the ablation circuit and/or the measurement circuit, if desired. In FIG. **6**A, each of the electrodes **438**A, **440**A used in the ablation circuit are coupled with the probe **422**, while each of the electrodes **444**A, **446**A used in the sensing circuit are skin patch electrodes that are disposed a distance away from the probe **422**.

(150) Referring now to FIG. **6**B, a variation from the sensing and ablation system illustrated in FIG. **6**A at reference number **420**A is now illustrated at reference number **420**B. The sensing and ablation system **420**B shown in FIG. **6**B may be the same as the sensing and ablation system **420**A illustrated in FIG. **6**A, except that only one of the sensing circuit electrodes is a patch electrode **446**B, while the other electrode **444**B making up the sensing circuit is disposed on the side **429** of the needle portion **430** of the probe **422** on the first ablation electrode **438**B. The first and second ablation electrodes **438**B, **440**B remain on the probe **422** as shown in FIG. **6**A.

(151) Referring now to FIG. **6**C, a variation from the sensing and ablation system illustrated in FIGS. **6**A and **6**B at reference numbers **420**A and **420**B is now illustrated at reference number **420**C. The sensing and ablation system **420**C shown in FIG. **6**C may be the same as the sensing and ablation system **420**A or **420**B illustrated in FIG. **6**A or **6**B, except that the first sensing electrode **444**C is disposed on the side **429** of the needle portion **430** of the probe **422** on the second ablation electrode **440**C, where the second ablation electrode **440**C extends to the distal end **424** of the needle portion **430**. The second sensing electrode **446**C is a patch electrode as previously shown in FIGS. **6**A and **6**B, and the first and second ablation electrodes **438**C, **440**C remain on the probe **422** as shown in FIGS. **6**A and **6**B.

(152) Referring now to FIG. **6**D, a variation from the sensing and ablation system illustrated in FIGS. **6**A, **6**B, and **6**C at reference numbers **420**A, **420**B, and **420**C is now illustrated at reference

number **420**D. The sensing and ablation system **420**D shown in FIG. **6**D may be the same as the sensing and ablation system **420**A, **420**B, or **420**C illustrated in FIG. **6**A, **6**B, or **6**C, except that the first ablation electrode **438**D is also used as the first sensing electrode **444**D in the sensing circuit. The second sensing electrode **446**D is a patch electrode as previously shown in FIGS. **6**A-**6**C, and the second ablation electrode **440**D remains on the distal end **424** of the probe **422** as shown in FIGS. **6**A-**6**C.

(153) Referring now to FIG. **6**E, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**D at reference numbers **420**A-**420**D is now illustrated at reference number **420**E. The sensing and ablation system **420**E shown in FIG. **6**E may be the same as the sensing and ablation system **420**A-**420**D illustrated in FIGS. **6**A-**6**D, except that the second ablation electrode **440**E disposed at the distal end **424** is also used as the first sensing electrode **444**E in the sensing circuit. The second sensing electrode **446**E is a patch electrode as previously shown in FIGS. **6**A-**6**D, and the first ablation electrode **440**E remains on the probe **422** as shown in FIGS. **6**A-**6**D.

(154) Referring now to FIG. **6**F, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**E at reference numbers **420**A-**420**E is now illustrated at reference number **420**F. The sensing and ablation system **420**F shown in FIG. **6**F may be the same as the sensing and ablation system **420**A-**420**E illustrated in FIGS. **6**A-**6**E, except that the first sensing electrode **444**F is disposed on the probe **422** in the area **442** between the first and second ablation electrodes **438**F, **440**F, which are disposed on the probe **422** as illustrated in FIGS. **6**A-**6**E. The second sensing electrode **446**F is a patch electrode as previously shown in FIGS. **6**A-**6**E, which is spaced a distance away from the probe **422**.

(155) Referring now to FIG. **6**G, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**F at reference numbers **420**A-**420**F is now illustrated at reference number **420**G. The sensing and ablation system **420**G shown in FIG. **6**G may be the same as the sensing and ablation system **420**A-**420**F illustrated in FIGS. **6**A-**6**F, except that the first sensing electrode **444**G is disposed on the distal tip **424** of the probe **422**, distally of the second ablation electrode **440**G, or farther from the proximal end **432** of the probe **422** than the ablation electrodes **438**G, **440**G are from the proximal end **432** of the probe **422**. The second sensing electrode **446**G is a patch electrode as previously shown in FIGS. **6**A-**6**F, which is spaced a distance away from the probe **422**. The first and second ablation electrodes **438**G, **440**G remain on the probe **422** as shown in FIGS. **6**A-**6**F.

(156) Referring now to FIG. **6**H, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**G at reference numbers **420**A-**420**G is now illustrated at reference number **420**H. The sensing and ablation system **420**H shown in FIG. **6**H may be the same as the sensing and ablation system **420**A-**420**G illustrated in FIGS. **6**A-**6**G, except that the first sensing electrode **444**H is disposed at the proximal end **432** of the probe **422**, farther from the distal end **424** than the first and second ablation electrodes **438**H, **440**H are from the distal end **424**. The second sensing electrode **446**H is a patch electrode as previously shown in FIGS. **6**A-**6**G, which is spaced a distance away from the probe **422**. The first and second ablation electrodes **438**H, **440**H remain on the probe **422** as shown in FIGS. **6**A-**6**G.

(157) Referring now to FIG. **6**I, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**H at reference numbers **420**A-**420**H is now illustrated at reference number **420**I. The sensing and ablation system **420**I shown in FIG. **6**I may be the same as the sensing and ablation system **420**A-**420**H illustrated in FIGS. **6**A-**6**H, except that the first sensing electrode **444**I is disposed on the side **429** of the needle portion **430** of the probe **422** on the first ablation electrode **438**I and the second sensing electrode **446**I is disposed on the side **429** of the needle portion **430** of the probe **422** on the second ablation electrode **440**I. In another variation (not pictured), both first and second sensing electrodes **444**I, **446**I may be located on the same ablation electrode **438**I, **440**I. The first and second ablation electrodes **438**I, **440**I remain on the probe **422** as shown in FIGS. **6**A-**6**H.

(158) Referring now to FIG. **6**J, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**I at reference numbers **420**A-**420**I is now illustrated at reference number **420**J. The sensing and ablation system **420**J shown in FIG. **6**J may be the same as the sensing and ablation system **420**A-**420**I illustrated in FIGS. **6**A-**6**I, except that the first sensing electrode **444**J is disposed on the side **429** of the needle portion **430** of the probe **422** on the first ablation electrode **438**J and the first ablation electrode **438**J is used as the second sensing electrode **446**J. The first and second ablation electrodes **438**J, **440**J remain on the probe **422** as shown in FIGS. **6**A-**6**I.

(159) Referring now to FIG. **6**K, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**J at reference numbers **420**A-**420**J is now illustrated at reference number **420**K. The sensing and ablation system **420**K shown in FIG. **6**K may be the same as the sensing and ablation system **420**A-**420**J illustrated in FIGS. **6**A-**6**J, except that the first sensing electrode **444**K is disposed on the side **429** of the needle portion **430** of the probe **422** on the first ablation electrode **438**K and the second ablation electrode **440**K is used as the second sensing electrode **446**K. The first and second ablation electrodes **438**K, **440**K remain on the probe **422** as shown in FIGS. **6**A-**6**J.

(160) Referring now to FIG. **6**L, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**K at reference numbers **420**A-**420**K is now illustrated at reference number **420**L. The sensing and ablation system **420**L shown in FIG. **6**L may be the same as the sensing and ablation system **420**A-**420**K illustrated in FIGS. **6**A-**6**K, except that the first sensing electrode **444**L is disposed on the side **429** of the needle portion **430** of the probe **422** on the first ablation electrode **438**L and the second ablation electrode **440**L is disposed in the area **442** between the first and second ablation electrodes **438**L, **440**L. The first and second ablation electrodes **438**L, **440**L remain on the probe **422** as shown in FIGS. **6**A-**6**K.

(161) Referring now to FIG. **6**M, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**L at reference numbers **420**A-**420**L is now illustrated at reference number **420**M. The sensing and ablation system **420**M shown in FIG. **6**M may be the same as the sensing and ablation system **420**A-**420**L illustrated in FIGS. **6**A-**6**L, except that the first sensing electrode **444**M is disposed on the side **429** of the needle portion **430** of the probe **422** on the first ablation electrode **438**M, and the second sensing electrode **446**M is disposed on the distal tip **424** of the probe **422**, distally of the second ablation electrode **440**M, or farther from the proximal end **432** of the probe **422** than the ablation electrodes **438**M, **440**M are from the proximal end **432** of the probe **422**. The first and second ablation electrodes **438**M, **440**M remain on the probe **422** as shown in FIGS. **6**A-**6**L.

(162) Referring now to FIG. **6**N, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**M at reference numbers **420**A-**420**M is now illustrated at reference number **420**N. The sensing and ablation system **420**N shown in FIG. **6**N may be the same as the sensing and ablation system **420**A-**420**M illustrated in FIGS. **6**A-**6**M, except that the first sensing electrode **444**N is disposed proximally of the first and second ablation electrodes **438**N, **440**N, or closer to the proximal end **432** of the probe **422** than the first and second ablation electrodes **438**N, **440**N are to the proximal end **432**. The second sensing electrode **446**N is disposed on the side **429** of the needle portion **430** of the probe **422** on the second ablation electrode **440**N. The first and second ablation electrodes **438**N, **440**N remain on the probe **422** as shown in FIGS. **6**A-**6**M.

(163) Referring now to FIG. **6**O, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**N at reference numbers **420**A-**420**N is now illustrated at reference number **420**O. The sensing and ablation system **420**O shown in FIG. **6**O may be the same as the sensing and ablation system **420**A-**420**N illustrated in FIGS. **6**A-**6**N, except that the first ablation electrode **438**O is used as the first sensing electrode **444**O, and the second ablation electrode **440**O is used as the second sensing electrode **446**O. The first and second ablation electrodes **438**O, **440**O remain on the probe **422** as shown in FIGS. **6**A-**6**N.

(164) Referring now to FIG. **6**P, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**O at reference numbers **420**A-**420**O is now illustrated at reference number **420**P. The

sensing and ablation system **420**P shown in FIG. **6**P may be the same as the sensing and ablation system **420**A-**420**O illustrated in FIGS. **6**A-**6**O, except that the first ablation electrode **438**P is used as the sensing electrode **444**P, and the second sensing electrode **446**P is disposed in the area **442** between the first and second ablation electrodes **438**P, **440**P. The first and second ablation electrodes **438**P, **440**P remain on the probe **422** as shown in FIGS. **6**A-**6**O.
(165) Referring now to FIG. **6**Q, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**P at reference numbers **420**A-**420**P is now illustrated at reference number **420**Q. The sensing and ablation system **420**Q shown in FIG. **6**Q may be the same as the sensing and ablation system **420**A-**420**P illustrated in FIGS. **6**A-**6**P, except that the first ablation electrode **438**Q is used as the first sensing electrode **444**Q, and the second sensing electrode **446**Q is disposed on the distal tip **424** of the probe **422**, distally of the second ablation electrode **440**Q, or farther from the proximal end **432** of the probe **422** than the ablation electrodes **438**Q, **440**Q are from the proximal end **432** of the probe **422**. The first and second ablation electrodes **438**Q, **440**Q remain on the probe **422** as shown in FIGS. **6**A-**6**P.
(166) Referring now to FIG. **6**R, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**Q at reference numbers **420**A-**420**Q is now illustrated at reference number **420**R. The sensing and ablation system **420**R shown in FIG. **6**R may be the same as the sensing and ablation system **420**A-**420**Q illustrated in FIGS. **6**A-**6**Q, except that the first sensing electrode **444**R is disposed proximally of the first and second ablation electrodes **438**R, **440**R, or closer to the proximal end **432** of the probe **422** than the first and second ablation electrodes **438**R, **440**R are to the proximal end **432**. The second ablation electrode **440**R is used as the second sensing electrode **446**R. The first and second ablation electrodes **438**R, **440**R remain on the probe **422** as shown in FIGS. **6**A-**6**Q.
(167) Referring now to FIG. **6**S, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**R at reference numbers **420**A-**420**R is now illustrated at reference number **420**S. The sensing and ablation system **420**S shown in FIG. **6**S may be the same as the sensing and ablation system **420**A-**420**R illustrated in FIGS. **6**A-**6**R, except that the first sensing electrode **444**S is disposed in the area **442** between the first and second ablation electrode **438**S, **440**S, and the second sensing electrode **446**S is disposed on the distal tip **424** of the probe **422**, distally of the second ablation electrode **440**S, or farther from the proximal end **432** of the probe **422** than the ablation electrodes **438**S, **440**S are from the proximal end **432** of the probe **422**. The first and second ablation electrodes **438**S, **440**S remain on the probe **422** as shown in FIGS. **6**A-**6**R.
(168) Referring now to FIG. **6**T, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**S at reference numbers **420**A-**420**S is now illustrated at reference number **420**T. The sensing and ablation system **420**T shown in FIG. **6**T may be the same as the sensing and ablation system **420**A-**420**S illustrated in FIGS. **6**A-**6**S, except that the first sensing electrode **444**T is disposed proximally of the first and second ablation electrodes **438**T, **440**T, or closer to the proximal end **432** of the probe **422** than the first and second ablation electrodes **438**T, **440**T are to the proximal end **432**. The second sensing electrode **446**T is disposed in the area **442** between the first and second ablation electrodes **438**T, **440**T. The first and second ablation electrodes **438**T, **440**T remain on the probe **422** as shown in FIGS. **6**A-**6**S.
(169) Referring now to FIG. **6**U, a variation from the sensing and ablation system illustrated in FIGS. **6**A-**6**T at reference numbers **420**A-**420**T is now illustrated at reference number **420**U. The sensing and ablation system **420**U shown in FIG. **6**U may be the same as the sensing and ablation system **420**A-**420**T illustrated in FIGS. **6**A-**6**T, except that the first sensing electrode **444**U is disposed proximally of the first and second ablation electrodes **438**U, **440**U, or closer to the proximal end **432** of the probe **422** than the first and second ablation electrodes **438**U, **440**U are to the proximal end **432**. The second sensing electrode **446**U is disposed at the distal end **424** of the probe **422**, further from the proximal end **432** than the ablation electrodes **438**U, **440**U are from the proximal end **432**. The first and second ablation electrodes **438**U, **440**U remain on the probe **422** as

shown in FIGS. **6**A-**6**T.

(170) Referring now to FIG. **7**A, a sensing and ablation system comprising five electrodes is illustrated and generally designated at **520**A. In the embodiment of FIG. **7**A, a pair of ablation potential electrodes **538**A, **540**A are disposed on a probe **522**, which is in the form of a needle having a pointed distal end **524**, similar to the variations shown in FIGS. **6**A-**6**U. Accordingly, the probe **522** is a bipolar ablation device. A non-energized portion **542** separates the pair of ablation potential electrodes **538**A, **540**A. Like the probes **22**, **122**, **222**, **322**, **422** of FIGS. **1**A-**4**J and **6**A-**6**U, the probe **522** of FIG. **7**A is configured to be inserted into the patient's anatomy for ablation of bodily tissue in the patient's anatomy.

(171) The pair of ablation electrodes **538**A, **540**A forms an ablation circuit. The first ablation electrode **538**A of the pair of ablation electrodes **538**A, **540**A delivers a source ablation signal, which travels through tissue near the probe **522** and turns into an ablation return signal, which is received by the second ablation electrode **540**A. Likewise, the second ablation electrode **540**A delivers a source ablation signal, which travels through tissue near the probe **522** and turns into an ablation return signal, which is received by the first ablation electrode **538**A. Thus, each of the ablation electrodes **538**A, **540**A sends an ablation signal into the patient's tissue to ablate the tissue. In the alternative, a single one of the pair of ablation electrodes **538**A, **540**A may send the ablation signal while the other of the pair of ablation electrodes **538**A, **540**A receives the ablation return signal.

(172) A first sensing electrode **544**A, a second sensing electrode **546**A, and a third sensing electrode **550**A make up a sensing circuit. One or more of the sensing electrodes **544**A, **546**A, **550**A sends out a sensing signal that is received another of the sensing electrodes **544**A, **546**A, **550**A. Thus, at least one of the sensing electrodes **544**A, **546**A, **550**A is an active electrode that is coupled with and energized by an electrode energy source. The receiving sensing electrode(s) **544**A, **546**A, **550**A is configured to provide data based on the measurement signal, for determining a complex impedance in the patient's anatomy while the active electrode is energized, as explained above. Thus, the measurement signal is passed between two or three of the sensing electrodes **544**A, **546**A, **550**A. As with the embodiment of FIGS. **3**A-**3**R, two of the sensing electrodes **544**A, **546**A, **550**A may be used at a time, but the three can be switched among to allow measurement in more than one location.

(173) With the variation of FIG. **7**A, the measurement source electrode and the ablation source electrode and the measurement return electrode and ablation return electrode may be different electrodes or the same electrodes. For example, although the pair of electrodes **538**A, **540**A are described as forming the ablation circuit and the electrodes **544**A, **546**A, **550**A are described as forming the measurement circuit, any of the electrodes **538**A, **540**A, **544**A, **546**A, **550**A may form a part of the ablation circuit and/or the measurement circuit, if desired.

(174) In FIG. **7**A, each of the electrodes **438**A, **440**A used in the ablation circuit are coupled with the probe **422**. The first sensing electrode **544**A is also coupled with the probe **522** and is disposed at the proximal end **532** of the probe **522**, farther from the distal end **524** than the first and second ablation electrodes **538**A, **540**A are from the distal end **524**. The second sensing electrode **546**A is coupled with the probe **522** and is disposed at the distal end **524** of the probe **522**. The third sensing electrode **550**A is a skin patch electrode that is disposed a distance away from the probe **522**, such as on the surface of a patient's skin.

(175) Referring now to FIG. **7**B, a variation from the sensing and ablation system illustrated in FIG. **7**A at reference number **520**A is now illustrated at reference number **520**B. The sensing and ablation system **520**B shown in FIG. **7**B may be the same as the sensing and ablation system **520**A illustrated in FIG. **7**A, except that the first and second ablation electrodes **538**B, **540**B are used as the first and second sensing electrodes **544**B, **546**B. The third sensing electrode **550**B remains as a patch electrode spaced a distance away from the probe **522**. The first and second ablation electrodes **538**B, **540**B remain on the probe **522** as shown in FIG. **7**A.

(176) Referring now to FIG. **7**C, a variation from the sensing and ablation system illustrated in FIGS. **7**A and **7**B at reference numbers **520**A and **520**B is now illustrated at reference number **520**C. The sensing and ablation system **520**C shown in FIG. **7**C may be the same as the sensing and ablation system **520**A or **520**B illustrated in FIG. **7**A or **7**B, except that the first sensing electrode **544**C is disposed on the side **529** of the needle portion **530** of the probe **522** on the first ablation electrode **538**C and the second sensing electrode **546**C is disposed on the side **529** of the needle portion **530** of the probe **522** on the second ablation electrode **540**C. The third sensing electrode **550**C is a patch electrode as previously shown in FIGS. **7**A and **7**B, and the first and second ablation electrodes **538**C, **540**C remain on the probe **522** as shown in FIGS. **7**A and **7**B.
(177) Referring now to FIG. **7**D, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**C at reference numbers **520**A-**520**C is now illustrated at reference number **520**D. The sensing and ablation system **520**D shown in FIG. **7**D may be the same as the sensing and ablation system **520**A-**520**C illustrated in FIGS. **7**A-**7**C, except that the first sensing electrode **544**D is disposed at the proximal end **532** of the probe **522**, farther from the distal end **524** than the first and second ablation electrodes **538**D, **540**D are from the distal end **524**. The second sensing electrode **546**D and the third sensing electrode **550**D are patch electrodes that are disposed a distance away from the probe **522** and from each other. The first and second ablation electrodes **538**D, **540**D remain on the probe **522** as shown in FIGS. **7**A-**7**C.
(178) Referring now to FIG. **7**E, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**D at reference numbers **520**A-**520**D is now illustrated at reference number **520**E. The sensing and ablation system **520**E shown in FIG. **7**E may be the same as the sensing and ablation system **520**A-**520**D illustrated in FIGS. **7**A-**7**D, except that the first sensing electrode **544**E is disposed in the area **542** between the first and second ablation electrodes **538**E, **540**E. The second sensing electrode **546**E and the third sensing electrode **550**E are patch electrodes that are disposed a distance away from the probe **522** and from each other. The first and second ablation electrodes **538**E, **540**E remain on the probe **522** as shown in FIGS. **7**A-**7**D.
(179) Referring now to FIG. **7**F, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**E at reference numbers **520**A-**520**E is now illustrated at reference number **520**F. The sensing and ablation system **520**F shown in FIG. **7**F may be the same as the sensing and ablation system **520**A-**520**E illustrated in FIGS. **7**A-**7**E, except that the first sensing electrode **544**F is disposed on the probe **522** at the proximal end **532** of the probe **522**, farther from the distal end **524** than the first and second ablation electrodes **538**F, **540**F are from the distal end **524**. The second sensing electrode **546**F is disposed on the probe **522** in the area **542** between the first and second ablation electrodes **538**F, **540**F, which are disposed on the probe **522** as illustrated in FIGS. **7**A-**7**E. The third sensing electrode **550**F is disposed at the distal end **524** of the probe **522**.
(180) Referring now to FIG. **7**G, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**F at reference numbers **520**A-**520**F is now illustrated at reference number **520**G. The sensing and ablation system **520**G shown in FIG. **7**G may be the same as the sensing and ablation system **520**A-**520**F illustrated in FIGS. **7**A-**7**F, except that the first sensing electrode **544**G is disposed on the side **529** of the needle portion **530** of the probe **522** on the first ablation electrode **538**G, the second sensing electrode **546**G is disposed on the area **542** between the first and second ablation electrodes **538**G, **540**G, and the third sensing electrode **550**G is disposed on the side **529** of the needle portion **530** of the probe **522** on the second ablation electrode **540**G. The first and second ablation electrodes **538**G, **540**G remain on the probe **522** as shown in FIGS. **7**A-**7**F.
(181) Referring now to FIG. **7**H, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**G at reference numbers **520**A-**520**G is now illustrated at reference number **520**H. The sensing and ablation system **520**H shown in FIG. **7**H may be the same as the sensing and ablation system **520**A-**520**G illustrated in FIGS. **7**A-**7**G, except that the first sensing electrode **544**H is disposed on the side **529** of the needle portion **530** of the probe **522** on the first ablation electrode **538**H, the second ablation electrode **540**H is used as the second sensing electrode **546**H, and the

third sensing electrode **550**H is a patch electrode that is spaced a distance away from the probe **522**. The first and second ablation electrodes **538**H, **540**H remain on the probe **522** as shown in FIGS. **7**A-**7**G.

(182) Referring now to FIG. **7**I, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**H at reference numbers **520**A-**520**H is now illustrated at reference number **520**I. The sensing and ablation system **520**I shown in FIG. **7**I may be the same as the sensing and ablation system **520**A-**520**H illustrated in FIGS. **7**A-**7**H, except that the first sensing electrode **544**I is disposed on the probe **522** at the proximal end **532** of the probe **522**, farther from the distal end **524** than the first and second ablation electrodes **538**I, **540**I are from the distal end **524**. The second ablation electrode **540**I is used as the second sensing electrode **546**I, and the third sensing electrode **550**I is a patch electrode that is spaced a distance away from the probe **522**. The first and second ablation electrodes **538**I, **540**I remain on the probe **522** as shown in FIGS. **7**A**7**H.

(183) Referring now to FIG. **7**J, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**I at reference numbers **520**A-**520**I is now illustrated at reference number **520**J. The sensing and ablation system **520**J shown in FIG. **7**J may be the same as the sensing and ablation system **520**A-**520**I illustrated in FIGS. **7**A-**7**I, except that the first ablation electrode **538**J is used as the first sensing electrode **544**J, the second sensing electrode **546**J is disposed at the distal end **524** of the probe **522**, and the third sensing electrode **550**J is a patch electrode that is spaced a distance away from the probe **522**. The first and second ablation electrodes **538**J, **540**J remain on the probe **522** as shown in FIGS. **7**A-**7**I.

(184) Referring now to FIG. **7**K, a variation from the sensing and ablation system illustrated in FIGS. **7**A-**7**J at reference numbers **520**A-**520**J is now illustrated at reference number **520**K. The sensing and ablation system **520**K shown in FIG. **7**K may be the same as the sensing and ablation system **520**A-**520**J illustrated in FIGS. **7**A-**7**J, except that the first sensing electrode **544**K is disposed proximally of the first and second ablation electrodes **538**K, **540**K, or closer to the proximal end **532** of the probe **522** than the first and second ablation electrodes **538**K, **540**K are to the proximal end **532**. In addition, the first ablation electrode **538**K is used as the second sensing electrode **546**K, and the second ablation electrode **540**K is used as the third sensing electrode **546**K. The first and second ablation electrodes **538**K, **540**K remain on the probe **522** as shown in FIGS. **7**A-**7**J.

(185) Further variations of a sensing and ablation system having a sensing circuit with three electrodes and an ablation circuit with two electrodes are illustrated in FIGS. **8**A and **8**B.

(186) These teachings can be expanded further to include instruments that include at least two probes with four or more electrodes. For example, FIGS. **9**A-**9**J illustrate several embodiments of a sensing and ablation system **920**A-**920**J having multiples needles, each having at least two electrodes disposed thereon.

(187) In FIG. **9**A, a sensing and ablation system is illustrated in FIG. **9**A and generally indicated reference number **620**A. In this variation, a pair of ablation potential electrodes **638**A, **640**A is disposed on a first probe **622**, which is in the form of a needle having a pointed distal end **624**. Similarly, another pair of ablation potential electrodes **654**A, **656**A are disposed on a second probe **636** (in the form of a needle having a pointed distal end **658**), the second probe **636** being spaced a distance away from the first probe **622**. Accordingly, the probes **622**, **636** are bipolar ablation devices. Non-energized portions **642**, **660** separate the pairs of ablation potential electrodes **638**A, **640**A, **654**A, **656**A, respectively. Like the probes **22**, **122**, **222**, **322**, **422**, **522** of FIGS. **1**A-**4**J and **6**A-**7**K, the probes **622**, **636** of FIG. **9**A are configured to be inserted into the patient's anatomy for ablation of bodily tissue in the patient's anatomy.

(188) The pairs of ablation electrodes **638**A, **640**A, **654**A, **656**A form one or more ablation circuits. For example, one or more of the ablation electrodes **638**A, **640**A, **654**A, **656**A delivers a source ablation signal, which travels through tissue near the probes **622**, **636** and turns into an ablation return signal, which is received by one of the other ablation electrodes **638**A, **640**A, **654**A, **656**A.

Thus, at least one of the ablation electrodes **638**A, **640**A, **654**A, **656**A sends an ablation signal into the patient's tissue to ablate the tissue.
(189) A first sensing electrode **644**A is disposed on the first probe **622**, and a second sensing electrode **646**A is disposed on the second probe **636**, wherein the first and second sensing electrodes **644**A, **646**A make up a sensing circuit. One or both of the sensing electrodes **644**A, **646**A sends out a sensing signal, or measurement signal, that is received by the other of the sensing electrodes **644**A, **646**A. Thus, at least one of the patch electrodes **644**A, **646**A is an active electrode that is coupled with and energized by an electrode energy source. The receiving sensing electrode(s) **644**A, **646**A is configured to provide data based on the measurement signal, for determining a complex impedance in the patient's anatomy while the active electrode is energized, as explained above. Thus, the measurement signal is passed between the sensing electrodes **644**A, **646**A.
(190) With the variation of FIG. **9**A, the measurement source electrode and the ablation source electrode and the measurement return electrode and ablation return electrode may be different electrodes or the same electrodes. For example, although the pairs of electrodes **638**A, **640**A, **654**A, **656**A are described as forming the ablation circuit and the pair of electrodes **644**A, **646**A is described as forming the measurement circuit, any of the electrodes **638**A, **640**A, **654**A, **656**A, **644**A, **646**A may form a part of the ablation circuit and/or the measurement circuit, if desired.
(191) In FIG. **9**A, all of the electrodes **638**A, **640**A, **654**A, **656**A, **644**A, **646**A are coupled with the probe **622**. The first sensing electrode **644**A is disposed on the area **642** between the first and second ablation electrodes **638**A, **640**A. The second sensing electrode **646**A is disposed on the area **660** between the third ablation electrode **654**A and the fourth ablation electrode **656**A.
(192) Referring now to FIG. **9**B, a variation from the sensing and ablation system illustrated in FIG. **9**A at reference number **620**A is now illustrated at reference number **620**B. The sensing and ablation system **620**B shown in FIG. **9**B may be the same as the sensing and ablation system **620**A illustrated in FIG. **9**A, except that the first sensing electrode **644**B is disposed on the distal end **624** of the first probe **622** and the second sensing electrode **646**B is disposed on the distal end **658** of the second probe **636**. The first and second ablation electrodes **638**B, **640**B remain on the first probe **622**, and the third and fourth ablation electrodes **654**B, **656**B remain on the second probe **636**, as shown in FIG. **9**A.
(193) Referring now to FIG. **9**C, a variation from the sensing and ablation system illustrated in FIGS. **9**A and **9**B at reference numbers **620**A and **620**B is now illustrated at reference number **620**C. The sensing and ablation system **620**C shown in FIG. **9**C may be the same as the sensing and ablation system **620**A or **620**B illustrated in FIG. **9**A or **9**B, except that the second ablation electrode **640**C is used as the first sensing electrode **644**C and the third ablation electrode **654**C is used as the second sensing electrode **646**C. The first and second ablation electrodes **638**C, **640**C remain on the first probe **622**, and the third and fourth ablation electrodes **654**C, **656**C remain on the second probe **636**, as shown in FIGS. **9**A and **9**B.
(194) Referring now to FIG. **9**D, a variation from the sensing and ablation system illustrated in FIGS. **9**A, **9**B, and **9**C at reference numbers **620**A, **620**B, and **620**C is now illustrated at reference number **620**D. The sensing and ablation system **620**D shown in FIG. **9**D may be the same as the sensing and ablation system **620**A, **620**B, or **620**C illustrated in FIG. **9**A, **9**B, or **9**C, except that both the sensing electrodes **644**D, **646**D are disposed on the first probe **622**. The first ablation electrode **638**D is used as the first sensing electrode **644**D, and the second ablation electrode **640**D is used as the second sensing electrode **646**D. The first and second ablation electrodes **638**D, **640**D remain on the first probe **622**, and the third and fourth ablation electrodes **654**D, **656**D remain on the second probe **636**, as shown in FIGS. **9**A-**9**C.
(195) Referring now to FIG. **9**E, a variation from the sensing and ablation system illustrated in FIGS. **9**A-**9**D at reference numbers **620**A-**620**D is now illustrated at reference number **620**E. The sensing and ablation system **620**E shown in FIG. **9**E may be the same as the sensing and ablation

system **620**A-**620**D illustrated in FIGS. **9**A-**9**D, except that the second ablation electrode **640**E is used as the first sensing electrode **644**E, and the second sensing electrode **646**E is a patch electrode that is spaced a distance away from the probes **622**, **636**. The first and second ablation electrodes **638**E, **640**E remain on the first probe **622**, and the third and fourth ablation electrodes **654**E, **656**E remain on the second probe **636**, as shown in FIGS. **9**A-**9**D.

(196) Referring now to FIG. **9**F, a variation from the sensing and ablation system illustrated in FIGS. **9**A-**9**E at reference numbers **620**A-**620**E is now illustrated at reference number **620**F. The sensing and ablation system **620**F shown in FIG. **9**F may be the same as the sensing and ablation system **620**A-**620**E illustrated in FIGS. **9**A-**9**E, except that the first ablation electrode **638**F is used as the first sensing electrode **644**F, and the second sensing electrode **646**F is a patch electrode disposed a distance away from the first and second probes **622**, **636**. The first and second ablation electrodes **638**F, **640**F remain on the first probe **622**, and the third and fourth ablation electrodes **654**F, **656**F remain on the second probe **636**, as shown in FIGS. **9**A-**9**E.

(197) Referring now to FIG. **9**G, a variation from the sensing and ablation system illustrated in FIGS. **9**A-**9**F at reference numbers **620**A-**620**F is now illustrated at reference number **620**G. The sensing and ablation system **620**G shown in FIG. **9**G may be the same as the sensing and ablation system **620**A-**620**F illustrated in FIGS. **9**A-**9**F, except that the first sensing electrode **644**G is disposed at the distal end **624** of the first probe **622**, and the second sensing electrode **646**G is a patch electrode that is disposed a distance away from the first and second probes **622**, **636**. The first and second ablation electrodes **638**G, **640**G remain on the first probe **622**, and the third and fourth ablation electrodes **654**G, **656**G remain on the second probe **636**, as shown in FIGS. **9**A-**9**F.

(198) Referring now to FIG. **9**H, a variation from the sensing and ablation system illustrated in FIGS. **9**A-**9**G at reference numbers **620**A-**620**G is now illustrated at reference number **620**H. The sensing and ablation system **620**H shown in FIG. **9**H may be the same as the sensing and ablation system **620**A-**620**G illustrated in FIGS. **9**A-**9**G, except that the first sensing electrode **644**H is disposed at the distal end **624** of the first probe **622**, and the second sensing electrode **646**H is disposed proximally of the needle portion **630** of the second probe **636**, such that the second sensing electrode **646**H is disposed closer to the proximal end **632** of the second probe **636** than the needle portion **630** is to the proximal end **622**. In other words, the second sensing electrode **646**H is disposed farther from the distal end **624** of the second probe **636** than the third and fourth ablation electrodes **654**H, **656**H are from the distal end **624**. The first and second ablation electrodes **638**H, **640**H remain on the first probe **622**, and the third and fourth ablation electrodes **654**H, **656**H remain on the second probe **636**, as shown in FIGS. **9**A-**9**G.

(199) Referring now to FIG. **9**I, a variation from the sensing and ablation system illustrated in FIGS. **9**A-**9**H at reference numbers **620**A-**620**H is now illustrated at reference number **620**I. The sensing and ablation system **620**I shown in FIG. **9**I may be the same as the sensing and ablation system **620**A-**620**H illustrated in FIGS. **9**A-**9**H, except that the first ablation electrode **638**I I used as the first sensing electrode **644**I, and the third ablation electrode **654**I is used as the second sensing electrode **646**I. The first and second ablation electrodes **638**I, **640**I remain on the first probe **622**, and the third and fourth ablation electrodes **654**I, **656**I remain on the second probe **636**, as shown in FIGS. **9**A-**9**H.

(200) Referring now to FIG. **9**J, a variation from the sensing and ablation system illustrated in FIGS. **9**A-**9**I at reference numbers **620**A-**620**I is now illustrated at reference number **620**J. The sensing and ablation system **620**J shown in FIG. **9**J may be the same as the sensing and ablation system **620**A-**620**I illustrated in FIGS. **9**A-**9**I, except that the first sensing electrode **644**J is disposed on the side **629** of the needle portion **630** of the first probe **622** on the second ablation electrode **640**J, and the second sensing electrode **646**J is disposed on the side **629** of the needle portion **630** of the second probe **636** on the third ablation electrode **654**J. The first and second ablation electrodes **638**J, **640**J remain on the first probe **622**, and the third and fourth ablation electrodes **654**J, **656**J remain on the second probe **636**, as shown in FIGS. **9**A-**9**I.

(201) Further variations of a two-probe system having two sets of electrodes on the probe and first and second sensing electrodes are illustrated in FIGS. **10**A-**10**C. Similarly, three or more probes could be used, without falling beyond the spirit and scope of the present disclosure.
(202) A further aspect of the disclosure provides a method of treating a patient using the ablation device as illustrated in a block diagram of FIG. **11**. In some embodiments, the method may include using bioelectrical impedance analysis (BIA) for ablation device positioning, power application, and endpoint detection. As used herein, BIA includes passing a low-level current through tissue and while doing so, measuring the resistance and/or the reactance, phase angle shift, and/or capacitance and inductance to determine an impedance. From the reactance and resistance, a complex impedance can be calculated. The complex impedance of tissue (including resistance, scalar impedance, and phase angle) may be analyzed to determine the type or state of tissue.
(203) One of the probes, or needles, described above may be used to create necrotic tissue by introducing energy to a tissue bundle or organ and through application of electrosurgical energy, heating the tissue until the tissue is no longer viable. In some embodiments, the method may include using sensors on an ablation device. The sensors may be able to both emit and receive signals of different types. For example, the method includes emitting at least a low level "measurement level" signal and a high level "ablation level" signal. The measurement signal may be applied at about 50 kHz and 800 μA, by way of example. The ablation signal may be applied at about 400-500 kHz, by way of example.
(204) In some embodiments, the method may include using one of the sensing and ablation systems **20**A-D, **120**A-G, **220**A-R, **320**A-J, **420**A-U, **520**A-K, **620**A-J described above, or another apparatus. In some embodiments, the method may include a step **702** of energizing a first electrode with a measurement level of power. The first electrode that is energized may be a skin patch electrode or an electrode that is coupled to a probe, as described above, by way of example. A probe, such as one of the needle probes above may be inserted into a position within a patient's anatomy. The measurement level of power is an amount sufficient to determine or measure a bulk tissue property, such as voltage drop, capacitance, resistance, reactance, or impedance, but preferably not high enough to significantly alter tissue. In other words, applying the measurement level of power to the patient's anatomy allows certain bulk tissue properties to be measured. In one variation, an impedance, such as a complex impedance is determined based on the bulk tissue property or properties measured. Accordingly the method may include a step **704** of measuring a bulk tissue property and/or determining an impedance of the patient's anatomy. A complex impedance includes resistance and reactance.
(205) In some embodiments, the method may further include a step **706** of determining whether the first position of the probe is a desired position of the probe, based on the bulk tissue property and/or the impedance. If the probe is not in a desired position, then probe may then be repositioned. The step **702** of energizing the first electrode with the measurement level of power may then be repeated until it is determined that the probe is in the desired position. The desired position is a position that is desired for ablating tissue in a patient. Based on the impedance determined or the bulk tissue property measured, the operator may estimate whether the probe is in the desired position.
(206) Once the probe is in the desired position, the method may include a step **708** of ablating tissue near the probe by energizing an electrode with an ablation level of power. The ablation level may be provided as high enough to ablate tissue, such as a tumor. The electrodes that are energized with the measurement level of power and the ablation level of power may be the same electrode of different electrodes, such as described with respect to FIGS. **1**A-**10**C. The ablation level of power is higher than the measurement level of power. The ablation level of power may be higher by virtue of higher level of driving current, higher level of driving voltage, same voltage and current but a longer duty cycle, a lower instantaneous driving current or voltage but with an even longer duty cycle.

(207) Thus, the measurement level of power merely causes the electrode to deliver a measurement signal, or a sensing signal, that is directed into the patient's tissue. The sensing signal may be a low level signal that causes no substantial change to the patient's tissue. The sensing signal is sent through the tissue merely to determine the tissue properties so that the operator may know whether the ablation probe has been properly placed to cause tissue ablation. The ablation signal, on the other hand, is high enough to cause tissue necrosis, by way of example. Thus, the sensing signal is lesser, or lower, than the ablation signal.
(208) The impedance may be determined by measuring a property, such as a bulk tissue property, of the patient. The impedance may be determined as a complex impedance, including both resistance (or scalar impedance) and phase angle, by way of example.
(209) In some embodiments, the method may include additional steps and refinements, as described below. For example, the method may include delivering a source measurement signal from the first electrode when the first electrode is energized, the source measurement signal being configured to pass through tissue and become a return measurement signal, the method may further comprise receiving the return measurement signal through a second electrode of the system. The second electrode may be provided on a measurement return device that is spaced a distance away from the probe, such as a skin patch electrode as shown and described above. In the alternative, the second electrode may be coupled with the probe, for example, in any of the configurations shown and described above wherein the second (or first) sensing electrode is disposed on a probe, or where both the first and second sensing electrodes are disposed on a probe.
(210) In some embodiments, the method may include delivering a source ablation signal from an ablation electrode (such as one of the electrodes in one of the systems **20**A, **120**A, **220**A, **320**A, **420**A, **520**A, **620**A). Typically, the ablation electrode is provided on a probe, as described above. For example, the method may also include delivering a source ablation signal from an ablation electrode (which could be the first electrode or another electrode) when the ablation electrode is energized, the source ablation signal being configured to pass through tissue and become an ablation return signal, the method may further comprise receiving the ablation return signal through an ablation return electrode of the system. The ablation return electrode may be the first electrode, the second electrode, a third electrode, or another electrode, by way of example. The ablation return electrode may be provided on a return device that is spaced a distance away from the probe, such as a skin patch electrode as shown and described above. In the alternative, the ablation return electrode may be coupled with the probe, for example, in any of the configurations shown and described above.
(211) In one variation, the one or more electrodes serving as the source of the measurement signal and the ablation signal are active electrodes, while the return electrodes are neutral electrodes that are not energized. In another variation, however, both the source electrodes and the return electrodes are energized, such that the measurement source electrode and the measurement return electrode are energized with opposite polarity to each other. Similarly, both the ablation source electrode and the ablation return electrode may be energized with opposite polarity to each other. In another variation, one of the measurement circuit or the ablation circuit may use a neutral return electrode, while the other of the measurement circuit and the ablation circuit has a return electrode that is charged with opposite polarity to the source electrode.
(212) When two electrodes are energized with opposite polarity in the ablation circuit, for example, a first ablation source signal is delivered from a first ablation electrode, and a second source ablation signal is delivered from a second ablation electrode. Each ablation signal turns into a return signal, such that the first ablation return signal is received by the second ablation electrode and the second ablation return signal is received by the first ablation electrode. In such a circuit, electrons flow from each ablation electron in a single direction at a time. As the signals oscillate between each ablation electrode, the electrons race toward whichever electrode has a more positive terminal.

(213) The measurement circuit may operate the same way. The measurement electrodes and the ablation electrodes may be common or different electrodes. For example, when two electrodes are energized with opposite polarity in the measurement circuit, a first measurement source signal is delivered from a first sensing electrode, and a second measurement source signal is delivered from a second sensing electrode. Each measurement signal turns into a return signal, such that the first measurement return signal is received by the second sensing electrode and the second measurement return signal is received by the first sensing electrode.
(214) Thus, in one aspect of the invention, the method may include locating a target object, such as a tumor, fibroid, tissue, or another other portion of a patient's anatomy for which ablation or BIA treatment is desired, in an anatomy of the patient by performing bioelectrical impedance analysis (BIA) on the anatomy of the patient, including determining a complex impedance in the patient's anatomy. This may be accomplishing by energizing an electrode with a measurement level of power, as explained above, using one of the apparatuses described above or another apparatus. In some embodiment, the method may include positioning a probe in a desired position for ablating the target object, based on the location of the target object determined by the step of locating the target object.
(215) In some variations, the method may include switching the sensing between different electrode groups during use of the device. The measurement signal may be sent continuously or non-continuously. For example, the measurement signal may be sent at set intervals, at trigger points (e.g., after another action has occurred), or at surgeon-controlled intervals. The measurement signal could be applied as alternating current (AC) or low level direct current (DC). For example, the DC measurement signals may be used in systems that determine a bulk tissue property such as resistance. An AC signal is used when complex impedance is being determined. The ablation signal is typically applied as AC, but could alternatively be applied as DC in some applications. Either signal could be applied with variable voltage or constant voltage. Typically, the ablation signal is applied with AC at about 400-500 kHz, to prevent muscle cramping.
(216) The measurement circuit may provide data for manipulation, and once the data is manipulated, for example, the system may determine an impedance in order to make an estimation regarding device positioning or location/condition of the target object. For example, the system could determine that the probe is in contact with certain tissue and is therefore properly placed (for example, in the middle of a tumor). The factors that the system may analyze may be impedance (reactance and/or phase angle between the output voltage and the output current), the amount of output current flowing through the tissue, resistance, temperature, or a combination thereof.
(217) In a system where remote (patch) electrodes and local electrodes (on the probe) are used, it is contemplated that the method may include comparison of whole body values, segmental values, from device to device (in multiple electrode context), probe to patch electrode (ground pad), and/or on the probe alone to provide information to the user about the tissue state and/or probe position.
(218) Any of the sensing and ablation systems **20**A, **120**A, **220**A, **320**A, **420**A, **520**A, **620**A or variations thereof may be used for the method described therein. Accordingly, in some variations, the measurement and ablation electrodes are common, or the same, and in other variations, different electrodes are used for the sensing circuit than for the ablation circuit.
(219) In some variations, the method may include sending a measurement signal, determining an impedance or a bulk tissue property, and then estimating a position of the probe based on the impedance or bulk tissue property. As discussed above, the signal may be sent as an AC signal or, in cases for determining a simple impedance, a DC signal. If the impedance indicates that the probe is not in the desired location, the probe is moved, and the process is repeated until it is determined that the probe is placed in the desired position. Thereafter, a higher ablation signal is sent to cause tissue necrosis.
(220) The description of the invention is merely exemplary in nature and variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such

variations are not to be regarded as a departure from the spirit and scope of the invention. For example, variations in the various figures can be combined with each without departing from the spirit and scope of the present disclosure.
(221) The preferred embodiment of the present invention has been disclosed. A person of ordinary skill in the art would realize, however, that certain modifications would come within the teachings of this invention. Therefore, the following claims should be studied to determine the true scope and content of the invention.
(222) Any numerical values recited in the above application include ail values from the lower value to the upper value in increments of one unit provided that there is a separation of at least 2 units between any lower value and any higher value. As an example, if it is stated that the amount of a component or a value of a process variable such as, for example, temperature, pressure, time and the like is, for example, from 1 to 90, preferably from 20 to 80, more preferably from 30 to 70, it is intended that values such as 15 to 85, 22 to 68, 43 to 51, 30 to 32 etc. are expressly enumerated in this specification. For values which are less than one, one unit is considered to be 0.0001, 0.001, 0.01 or 0.1 as appropriate. These are only examples of what is specifically intended and all possible combinations of numerical values between the lowest value and the highest value enumerated are to be considered to be expressly stated in this application in a similar manner.
(223) Unless otherwise stated, all ranges include both endpoints and all numbers between the endpoints, the use of “about” or “approximately” in connection with a range apply to both ends of the range. Thus, “about 20 to 30” is intended to cover “about 20 to about 30”, inclusive of at least the specified endpoints.
(224) The disclosures of all articles and references, including patent applications and publications, are incorporated by reference for all purposes.
(225) The term “consisting essentially of” to describe a combination shall include the elements, ingredients, components or steps identified, and such other elements ingredients, components or steps that do not materially affect the basic and novel characteristics of the combination.
(226) The use of the terms “comprising” or “including” describing combinations of elements, ingredients, components or steps herein also contemplates embodiments that consist essentially of the elements, ingredients, components or steps.

Claims

1. A method of treating a target tissue in a patient using a needle probe including a plurality of needle probe electrodes located on the needle probe positioned proximate target tissue, the method comprising: measuring a bulk tissue property using a sensing circuit formed between at least one needle probe electrode of the plurality of needle probe electrodes and at least another needle probe electrode of the plurality of needle probe electrodes; indicating for repositioning, based on at least the bulk tissue property, the needle probe to a location where the needle probe can treat the target tissue; and after the repositioning, ablating the target tissue using an ablation circuit formed between at least one needle probe electrode of the plurality of needle probe electrodes and at least one ablation electrode.
2. The method of claim 1, further comprising prohibiting delivery of treatment energy via the ablation circuit via the needle probe when the needle probe is positioned away from the location where the needle probe can treat the target tissue.
3. The method of claim 1, further comprising: repeating measuring the bulk tissue property and repeating the indicating for repositioning until the location meets at least one location criterion; and enabling delivering of treatment energy via the ablation circuit in response to the location meeting the at least one location criterion.
4. The method of claim 1, further comprising energizing the sensing circuit in a bipolar manner.
5. The method of claim 1, wherein measuring the bulk tissue property comprises providing a

measurement level of power via the sensing circuit.
6. The method of claim 5, wherein ablating the target tissue comprises providing a treatment level of power via the ablation circuit, the treatment level of power being greater than the measurement level of power.
7. The method of claim 1, wherein the bulk tissue property comprises at least one of impedance, resistance, reactance, capacitance, or inductance.
8. The method of claim 1, wherein the sensing circuit and the ablation circuit include a same needle probe electrode of the plurality of needle probe electrodes.
9. The method of claim 1, wherein the at least one ablation electrode includes a needle probe electrode disposed on the needle probe.
10. The method of claim 1, wherein the at least one ablation electrode includes a skin patch electrode.
11. A method of treating a target tissue in a patient using a needle probe including a plurality of needle probe electrodes located on the needle probe positioned proximate the target tissue, the method comprising: measuring a bulk tissue property using a sensing circuit formed between at least one needle probe electrode of the plurality of needle probe electrodes and at least another needle probe electrode of the plurality of needle probe electrodes; indicating for repositioning, based on the bulk tissue property, the needle probe to a location where the needle probe can treat the target tissue; and after the repositioning, ablating the target tissue using an ablation circuit formed between at least one needle probe electrode of the plurality of needle probe electrodes and at least another needle probe electrode of the plurality of needle probe electrodes.
12. The method of claim 11, further comprising energizing the sensing circuit in a bipolar manner.
13. The method of claim 11, wherein: measuring the bulk tissue property comprises providing a measurement level of power via the sensing circuit; ablating the target tissue comprises providing a treatment level of power via the ablation circuit; and the treatment level of power is greater than the measurement level of power.
14. The method of claim 11, wherein the sensing circuit and the ablation circuit include a same needle probe electrode of the plurality of needle probe electrodes.
15. The method of claim 11, wherein the bulk tissue property comprises at least one of impedance, resistance, reactance, capacitance, or inductance.
16. A method of treating a target tissue in a patient using a needle probe including a plurality of needle probe electrodes located on the needle probe positioned proximate the target tissue, the method comprising: measuring a bulk tissue property using a sensing circuit formed between at least one needle probe electrode of the plurality of needle probe electrodes and at least another needle probe electrode of the plurality of needle probe electrodes; indicating for repositioning, based on the bulk tissue property, the needle probe to a location where the needle probe can treat the target tissue; and after the repositioning, ablating the target tissue using an ablation circuit formed between at least one needle probe electrode of the plurality of needle probe electrodes and a skin patch electrode.
17. The method of claim 16, further comprising energizing the sensing circuit in a bipolar manner.
18. The method of claim 16, wherein: measuring the bulk tissue property comprises providing a measurement level of power via the sensing circuit; ablating the target tissue comprises providing a treatment level of power via the ablation circuit; and the treatment level of power is greater than the measurement level of power.
19. The method of claim 16, wherein the sensing circuit and the ablation circuit include a same needle probe electrode of the plurality of needle probe electrodes.
20. The method of claim 16, wherein the bulk tissue property comprises at least one of impedance, resistance, reactance, capacitance, or inductance.