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(54) **DYNAMICALLY ADJUSTED ANTENNA SYSTEM AND ANTENNA ARRAY INCLUDED THEREIN**

DYNAMISCH ANGEPASSTES ANTENNENSYSTEM UND DARIN ENTHALTENE ANTENNENANORDNUNG

SYSTÈME D'ANTENNES À AJUSTEMENT DYNAMIQUE ET RÉSEAU D'ANTENNES INCLUS DANS CE SYSTÈME

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an antenna system, and more particular to an antenna system including an antenna array, whose conditions can be dynamically adjusted.

BACKGROUND OF THE INVENTION

[0002] In many applications, a directional antenna array is often used for sensing the specific directional state of the external environment. For example, a directional array antenna can be used to sense the surrounding obstacles appearing in the specific direction in the driving route of a car. For example, US 6,885,345 B2 and US 10,027,014 B2 disclose antenna apparatus adapted to be used with vehicles. EP3624354, which belongs to the state of the art under Article 54(3) EPC, discloses a radio relay device wherein the antenna units are connected to each other via a transmission line that is disposed on a flexible substrate, and two radio ICs convert the signal to the baseband before sending it to the transmission line to avoid EM radiation.

[0003] A directional antenna array generally includes a plurality of antennas allocated in a specified manner and combined as an antenna assembly having an overall beam direction associated with respective electromagnetic waves of the antenna units. The circuit board for mounting thereon the antenna units is usually a multilayer printed circuit board (PCB), which is advantageous in stabilizing the overall beam direction of the antenna array due to its stable and non-deformable natures. For example, US 2010/168727 A1 and US 2002/024468 A1 disclose fixed configurations of antenna arrays. On the other hand, just because of the stable and non-deformable natures of the multilayer printed circuit board, the beam direction of the antenna array is fixed, and thus the coverage range of the beam is confined. The limited coverage range also means the limited applications, and the structure of antenna arrays would need to be particularly designed in order to properly adjust the coverage range and make better sensing performance.

SUMMARY OF THE INVENTION

[0004] Therefore, the present invention provides an antenna system including an antenna array, according to claim 1, a control device and a driving mechanism. The antenna array includes a plurality of antenna units disposed on a flexible substrate, wherein a configuration of the flexible substrate is variable so as to change relative positions of at least two of the antenna units. The control device determines the configuration of the flexible substrate according to a default setting or in response to a dynamic input. The driving mechanism is connected between the flexible substrate and the control device for driving the change of the configuration of the flexible substrate in response to a command from the control device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The invention will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, in which:

FIG. 1A is a schematic diagram illustrating an antenna array according to an embodiment of the present invention;

FIG. IB is a schematic diagram illustrating partially an antenna array according to another embodiment of the present invention;

FIG. 2 is a schematic cross-sectional view illustrating a partial antenna array according to another embodiment of the present invention;

FIG. 3 is a schematic diagram illustrating a systematic structure of an antenna system including the antenna array of FIG. 2;

FIG. 4 is a scheme illustrating an initial state and a bending state of the antenna array in the antenna system of FIG. 3; and

FIG. 5 is a schematic cross-sectional view illustrating a partial antenna array according to a further embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0006] Please refer to FIG. 1A, which schematically shows the configuration of an antenna array according to an embodiment of the invention. As shown, the antenna array 10 includes an antenna substrate 100, antenna units 110, and signal transmission lines 120. The antenna substrate 100 is defined with two or more antenna installation regions 1010 and a corresponding number of connecting regions 1020, which interconnect the antenna installation regions 1010 in a flexible manner. The portion of the antenna substrate 100, where the connecting regions 1020 are located, is locally deformable or bendable, thereby making the connecting regions 1020 flexible. The antenna units 110 includes a plurality of antenna units 1101, 1102,...,1109 disposed in the antenna installation regions 1010, and each of the signal transmission lines 120 is disposed in one of the connecting regions 1020. Basically, each of the connecting regions 1020 is disposed for connecting two antenna installation regions 1010. The layout of the antenna installation regions 1010 and the connecting regions 1020 are specifically designed so that a signal SI coupled to the antenna array can be delivered among any of the antenna units 110 included in the antenna array 10 via conductive wires, which include the conductive wires in the antenna units and other conductive wires in the antenna installation regions 1010, and the signal transmission lines 120. The antenna array 10 can thus generate a certain pattern of electromagnetic wave field corresponding to the input signal SI, for communication or detection of the state of the surrounding environment accordingly. On the other hand, a signal from any of the antenna units 110 can also be transmitted out of the antenna array via the conductive wires

[0007] It is to be noted that the signal transmission lines 120, although expressed as straight lines in FIG. 1A, may be configured to be another shape. For example, it may be consistent battlement-shaped, as illustrated in FIG. 1B, polygon-shaped or curve-shaped. Furthermore, as the design requirement of the antenna array 10 changes, e.g. the pattern of the electromagnetic wave field changes, it is feasible to install two of the antenna units 110, e.g. the antenna units 1107 and 1108, in the same antenna installation region 1010, e.g. the antenna installation region 10108, while having one of the antenna installation regions 1010, e.g. the antenna installation region 10105, vacant without any antenna unit 110 installed therein. Likewise, as long as signals can be successfully transmitted to each of the designated antenna units 110, the connecting regions 1020 may be selectively and optionally used for disposing the signal transmission lines 120. Furthermore, the width of one or each of the connecting regions 1020 may be the same as or narrower than the width of one or each of the antenna installation regions 1010. The configuration of the antenna array 10 shown in FIG. 1 is only one implementing example of the present invention, and it is not intended to limit the applications of the present invention to the illustrated example.

[0008] Next, please refer to FIG. 2, which is a cross-sectional view schematically exemplifying the disposition of the antenna units and signal transmission lines on the substrate and the stackup of the substrate. In the embodiment shown in FIG. 2, three antenna units 210, 212 and 214 or more are included, wherein the antenna units 210 and 212 are disposed in the same antenna installation region 2010, and the antenna unit 214 is disposed in another antenna installation region 2030. The portion of the antenna substrate 100 defined with each of the antenna installation regions 2010 and 2030 is made of a four-layer printed circuit board. For example, four separate layers 2012, 2014, 2016 and 2018 are stacked in sequence to form the printed circuit board in the antenna installation region 2010, and four separate layers 2032, 2034, 2036 and 2038 are stacked in sequence to form the printed circuit board antenna installation region 2030. For forming some of these layers, e.g. the inner layers 2014, 2016, 2034 and 2036, a dielectric material having relatively flexible and electrically insulating properties may be properly used, and for some other layers, e.g. the outer layers 2012, 2018, 2032, and 2038, a relatively rigid and non-deformable insulating material may be properly used. Moreover, the portion of the antenna substrate, where the signal transmission line 220 is located, forms a flexible or bendable layer 2020. With the above-described specific allocation and distribution of flexible and rigid material, parts of the antenna substrate 100 are inflexible while the overall antenna substrate 100 exhibits a flexible state.

[0009] In this embodiment, the antenna units 210 and 212 are disposed on the surface of the uppermost layer 2012 in the antenna installation region 2010, and the antenna unit 214 is disposed on the uppermost layer 2032 in the antenna installation region 2030. A signal transmission line 220 that transmits signals among the antenna units 210, 212, and 214 is extensively disposed on the surfaces of the layers 2014, 2020 and 2034, and is electrically coupled to the antenna units 210, 212, and 214. The layers 2014, 2020 and 2034 may, but not necessarily, be made of the same flexible material to form a continuous layer and may also be produced in the same process so that integrity among the units can be enhanced and to avoid cracks. In other words, since the layers 2014 and 2034 are made of soft material, one or both of them may extend outside the antenna installation regions 2010 and/or 2030 to serve as the flexible or bendable layer 2020, or the flexible or bendable layer 2020 may extend into the antenna installation regions 2010 and/or 2030 to function like the layers 2014 and/or 2034. The smaller thickness of the layer 2020 than the overall thickness of the composite layers in the antenna installation region 2010 or 2030 facilitates flexibility of the entire structure, and also provides a space 2021 thereunder for accommodating a flexible or bendable shift from a substrate portion from the antenna installation regions 2010 and/or 2030.

[0010] It should be noted that the substrate portions in both the antenna installation regions 2010 and 2030 are a multilayer printed circuit board including two or more layers in the above embodiments. Alternatively, the substrate portions in the antenna installation regions 2010 and 2030 may have different configurations. For example, they may have different numbers of layers, varying with different practical requirements. Likewise, although the substrate portion in the connecting region is a single layer, the flexible or bendable layer 2020 may also be designed to include multiple layers 2020a, 2020b and 2020c of dielectric material, if practically required, as illustrated in FIG. 5. In the embodiment shown in FIG. 2, the signal transmission line 220 is disposed within the layers 2014, 2020 and 2034. In the embodiment as shown FIG. 5, the signal transmission line 220 is disposed on the layer 2020b and covered by the layer 2020a. As shown in FIG. 5, the layer 2014 further includes two sub-layers 2014a and 2014b, and the signal transmission line 220 is disposed on the layer 2014b and covered by the layer 2014a.

[0011] Next, please refer to FIG. 3, which is a schematic diagram of a system architecture of an antenna system according to an embodiment of the invention. The antenna system 30 in this embodiment includes the antenna array shown in FIG. 2 and is equipped with a control device composed of a supporting frame including supporting segments 3000 and 3010, a driving structure including driving rods 3100 and 3110 and a servo motor 3200, and a driving controller 3300. With the configuration as shown, an effect of changing positions of the antenna array and adjusting bending degrees of the flexible substrate according to a control command can be achieved. In an embodiment, the control command may be automatically generated and provided for the driving controller 3300 by deep sensing learning in response to a sensing result of a sensing device, which is included in or external to the antenna system. For example, a motion sensor such as a passive infrared (PIR) sensor or a radar sensor senses data of a target angle and/or other motional parameters of an object in the detected region where the antenna system 30 is disposed and conducts a monitoring operation. Then the data of the target angle and/or motional parameters of the object is outputted to the driving controller 3300, and the driving controller 3300 determines how the state of the antenna array is to be changed according to the sensing result. Then the driving controller 3300 issues a control command to have the servo motor 3200 drives the supporting frame 3000 to bend via the driving rods 3100 and/or 3110, thereby adjusting a configuration of the antenna array, e.g. relative positions of the antenna units included in the antenna array. FIG. 4 schematically illustrates an initial state and a bending state of the antenna array, in which the circles 400, 410, and 420 represent the relative positions of the three antenna units 210, 212 and 214. The scheme in FIG. 4 shows that in the initial state, the positions 400 and 420 are different and horizontally apart from each other with a distance X1, and different and vertically apart from each other with a distance Y1. As shown in the figure, the length L1 is the length of the signal transmission line 220 between the positions 400 and 420, wherein the signal transmission line 220 interconnects the three antenna units 210, 212 and 214. When adjustment of the state of the antenna array is required, the location of the antenna units of the antenna array is adjusted by the servo motor 3200. As shown, the antenna unit 210 is originally located at the position 400. It is to be noted that the position 400 is not necessarily a fixed location, and it may be variable in other applications. The driving controller 3300 controls the servo motor 3200 to respectively move the locations of the antenna units 212 and 214 from the original positions 410 and 420to the positions 410a and 420a as respectively shown in FIG. 4. Since the length L2 of the signal transmission line, after being adjusted, will not change and is still equal to the length L1. Accordingly, the horizontal distance between the positions 400 and 420a changes from X1 to X2, and the vertical distance between the positions 400 and 420a changes from Y1 to Y2. As a result, the pattern of the electromagnetic wave field derived from the three antenna units can be adjusted by changing the relative positions of the associated antenna units.

[0012] In this embodiment, each of the supporting segment 3000 and 3010 is relatively rigid to maintain a fixed shape, e.g. a planar shape. The supporting segment 3000 can be used to secure the structure in the antenna installation region 2010, and the supporting segment 3010 can be used to fix the structure in the antenna installation region 2030. The driving rod 3100 is coupled to the supporting segment 3000 and the servo motor 3200, and transmitted to adjust the position of the supporting segment 3000 by the servo motor 3200. Likewise, the driving rod 3110 is coupled to the supporting segment 3010 and the servo motor 3200, and transmitted to adjust the position of the supporting segment 3010 by the servo motor 3200. The driving controller 3300 is electrically coupled to the servo motor 3200, and controls the operation of the servo motor 3200 according to preset or dynamically inputted conditions, thereby controlling the motions of the driving rods 3100 and 3110. With the movement of the driving rods 3100 and 3110, the positions of the supporting segments 3000 and 3010, and the angle θ between the supporting segments 3000 and 3010 will change, so as to change the relative positions of the antenna units 210, 212, and 214. Accordingly, the electromagnetic wave field pattern along with the emitted electromagnetic waves will change as well. In this way, the layout of the antenna array can be flexibly designed and the relative positions of the array units in the antenna array can be dynamically adjusted to create desired patterns of electromagnetic wave field.

[0013] The present invention may involve in a variety of applications in our daily lives. For example, safety of a car equipped with headlights rotating with its steering wheel may be further enhanced by installing an antenna array according to the present invention on the lamp holders of the headlights or any other suitable place where antenna detection is required. The configuration of the antenna array can be synchronously determined and adjusted according to the directional rotating degrees of the steering wheel or the headlight(s) to realize more reliable information for driving safety. In another example, an antenna array according to the present invention may be disposed on one or more gravity sensors (G sensors) in rearview mirrors of a car to provide important driving information for the driver. The antenna array according to the present invention may also be used in a camera for detecting or compensating a focus shift problem.

[0014] In view of the foregoing, by installing antenna units on a flexible substrate to form an antenna array, a configuration of the antenna array, e.g. relative positions of the antenna units included in the antenna array, can be dynamically and finely adjusted to provide a desirable configuration of the antenna array for some specific purpose. The adjustment of the relative positions of the antenna units can be readily achieved as a result of a relative motion between portions of the flexible substrate in response a default setting or a dynamic input command. Furthermore, a substrate can be made flexible by a variety of ways. For example, it can be accomplished by way of selected material and/or structural design.

Claims

1. An antenna array, comprising:

at least first and second antenna units (110, 1101-1109, 210, 212, 214); and
a signal transmission line (120, 220) directly connected to the first and second antenna units (110, 1101-1109, 210, 212, 214) for delivering a signal between the first and second antenna units (110, 1101-1109, 210, 212, 214); and
a flexible substrate (100), in which at least first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) are defined for supporting at least the first and second antenna units (110, 1101-1109, 210, 212, 214), respectively, and a connecting region (1020) disposed between the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) for supporting at least the signal transmission line (120, 220), wherein a substrate portion in each of the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) includes at least two layers (2012, 2014, 2016, 2018, 2032, 2034, 2036, 2038) stacked in sequence, and **characterized by** further comprising:
a substrate
portion in the connecting region (1020) configured to be more flexible than the substrate portion in each of the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) so that the substrate portion in the first antenna installation region (1010, 10105, 10108, 2010, 2030) and the substrate portion in the second antenna installation region (1010, 10105, 10108, 2010, 2030) are dynamically movable relative to each other for adjusting a configuration of the antenna array by driving the substrate portion in the connecting region (1020) to bend.

2. The antenna array according to claim 1, wherein a specified one of the at least two layers (2014, 2034) of the substrate portion in each of the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) and the substrate portion (2020) in the connecting region (1020) are made of a flexible material and interconnected as a continuous layer.

3. The antenna array according to claim 2, wherein the other one of the least two layers (2012, 2018, 2032, 2038) of the substrate portion in each of the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) is made of less flexible material than the specified one of the at least two layers (2014, 2034) for installing thereon the first/second antenna unit (110, 1101-1109, 210, 212, 214).

4. The antenna array according to claim 1, wherein the substrate portion in the connecting region (1020) is thinner than the substrate portion in each of the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) such that a space (2021) under the substrate portion in the connecting region (1020) between the substrate portions in the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) is remained.

5. The antenna array according to claim 1, further comprising a third antenna unit (1107/1108, 210/212) supported by the same substrate portion in the first or second antenna installation region (10108, 2010), and interconnected with the first and second antenna units (210/212, 214) by the signal transmission line (120, 220).

6. The antenna array according to claim 1, wherein the substrate portion in each of the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) is implemented with a multilayer printed circuit board.

7. The antenna array according to claim 1, wherein the substrate portion in the connecting region (1020) is implemented with single or multiple dielectric layers.

8. An antenna system, comprising:

an antenna array (10) according to claim 1;
a control device (3000, 3010) configured to determine a configuration of the flexible substrate (100) according to a default setting or in response to a dynamic input; and
a driving mechanism (3100, 3110, 3200, 3300) connected between the flexible substrate (100) and the control device (3000, 3010) for driving a change of the configuration of the flexible substrate (100) in response to a command from the control device.

9. The antenna system according to claim 8, wherein the control device is further configured to determine a relative motion between the substrate portion in the first antenna installation region (1010, 10105, 10108, 2010, 2030) and the substrate portion in the second antenna installation region (1010, 10105, 10108, 2010, 2030) according to the default setting or in response to the dynamic input.

10. The antenna system according to claim 8, wherein the driving mechanism (3100, 3110, 3200, 3300) is connected to the substrate portions in the first and second antenna installation regions (1010, 10105, 10108, 2010, 2030) and the control device (3000, 3010) for driving the relative motion in response to the command from the control device.

Patentansprüche

1. Antennenanordnung, umfassend:

   mindestens eine erste und zweite Antenneneinheit (110, 1101-1109, 210, 212, 214); und
   eine Signalübertragungsleitung (120, 220), die direkt mit der ersten und zweiten Antenneneinheit (110, 1101-1109, 210, 212, 214) verbunden ist, zum Übermitteln eines Signals zwischen der ersten und zweiten Antenneneinheit (110, 1101-1109, 210, 212, 214); und
   ein flexibles Substrat (100), in welchem mindestens eine erste und zweite Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) zum Tragen von mindestens der ersten bzw. zweiten Antenneneinheit (110, 1101-1109, 210, 212, 214) und eine Verbindungsregion (1020), die zwischen der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) angeordnet ist, zum Tragen von mindestens der Signalübertragungsleitung (120, 220) definiert sind, wobei ein Substratabschnitt in jeder der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) mindestens zwei Schichten (2012, 2014, 2016, 2018, 2032, 2034, 2036, 2038) umfasst, die nacheinander gestapelt sind,
   gekennzeichnet durch
   einen Substratabschnitt in der Verbindungsregion (1020), der dazu konfiguriert ist, flexibler zu sein als der Substratabschnitt in der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030), so dass der Substratabschnitt in der ersten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) und der Substratabschnitt in der zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) dynamisch relativ zu einander beweglich sind, um eine Konfiguration der Antennenanordnung anzupassen, indem der Substratabschnitt in der Verbindungsregion (1020) so angetrieben wird, dass er sich krümmt.

2. Antennenanordnung nach Anspruch 1, wobei eine spezifizierte der mindestens zwei Schichten (2014, 2034) des Substratabschnitts in jeder der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) und der Substratabschnitt (2020) in der Verbindungsregion (1020) aus einem flexiblen Material hergestellt sind und als eine durchgehende Schicht miteinander verbunden sind.

3. Antennenanordnung nach Anspruch 2, wobei die andere der mindestens zwei Schichten (2012, 2018, 2032, 2038) des Substratabschnitts in jeder der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) aus einem weniger flexiblen Material als die spezifizierte eine der mindestens zwei Schichten (2014, 2034) zur Installation der ersten/zweiten Antenneneinheit (110, 1101-1109, 210, 212, 214) darauf hergestellt ist.

4. Antennenanordnung nach Anspruch 1, wobei der Substratabschnitt in der Verbindungsregion (1020) dünner als der Substratabschnitt in jeder der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) ist, sodass ein Raum (2021) unter dem Substratabschnitt in der Verbindungsregion (1020) zwischen den Substratabschnitten in der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) bestehen bleibt.

5. Antennenanordnung nach Anspruch 1, ferner umfassend eine dritte Antenneneinheit (1107/1108, 210/212), die durch denselben Substratabschnitt in der ersten oder zweiten Antenneninstallationsregion (10108, 2010) getragen wird und durch die Signalübertragungsleitung (120, 220) mit der ersten und zweiten Antenneneinheit (210/212, 214) verbunden ist.

6. Antennenanordnung nach Anspruch 1, wobei der Substratabschnitt in jeder der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) mit einer mehrschichtigen gedruckten Leitplatte implementiert ist.

7. Antennenanordnung nach Anspruch 1, wobei der Substratabschnitt in der Verbindungsregion (1020) mit einer einzelnen oder mehreren dielektrischen Schichten implementiert ist.

8. Antennensystem, umfassend:

   eine Antennenanordnung (10) nach Anspruch 1;
   eine Steuervorrichtung (3000, 3010), die dazu konfiguriert ist, eine Konfiguration des flexiblen Substrats (100) gemäß einer Standardeinstellung oder als Reaktion auf eine dynamische Eingabe zu bestimmen; und
   einen Antriebsmechanismus (3100, 3110, 3200, 3300), der zwischen dem flexiblen Substrat (100) und der Steuervorrichtung (3000, 3010) verbunden ist, zum Antreiben einer Änderung der Konfiguration des flexiblen Substrats (100) als Reaktion auf einen Befehl von der Steuervorrichtung.

9. Antennensystem nach Anspruch 8, wobei die Steuervorrichtung ferner dazu konfiguriert ist, eine relative Bewegung zwischen dem Substratabschnitt in der ersten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) und dem Substratabschnitt in der zweiten Antenneninstallationsregion

(1010, 10105, 10108, 2010, 2030) gemäß der Standardeinstellung oder als Reaktion auf die dynamische Eingabe zu bestimmen.

10. Antennensystem nach Anspruch 8, wobei der Antriebsmechanismus (3100, 3110, 3200, 3300) mit den Substratabschnitten in der ersten und zweiten Antenneninstallationsregion (1010, 10105, 10108, 2010, 2030) und der Steuervorrichtung (3000, 3010) zum Antreiben der relativen Bewegung als Reaktion auf den Befehl von der Steuervorrichtung verbunden ist.

Revendications

1. Réseau d'antennes, comprenant :

au moins des première et deuxième unités d'antenne (110, 1101 à 1109, 210, 212, 214) ; et
une ligne de transmission de signal (120, 220) connectée directement aux première et deuxième unités d'antenne (110, 1101 à 1109, 210, 212, 214) pour délivrer un signal entre les première et deuxième unités d'antenne (110, 1101 à 1109, 210, 212, 214) ; et
un substrat souple (100), dans lequel au moins des première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) sont définies pour supporter au moins les première et deuxième unités d'antenne (110, 1101 à 1109, 210, 212, 214), respectivement, et une région de connexion (1020) disposée entre les première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) pour supporter au moins la ligne de transmission de signal (120, 220), dans lequel une portion de substrat dans chacune des première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) comporte au moins deux couches (2012, 2014, 2016, 2018, 2032, 2034, 2036, 2038) empilées en séquence, et **caractérisé en ce qu'**il comprend en outre:
une portion de substrat dans la région de connexion (1020) configurée pour être plus souple que la portion de substrat dans chacune des première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) de sorte que la portion de substrat dans la première région d'installation d'antenne (1010, 10105, 10108, 2010, 2030) et la portion de substrat dans la seconde région d'installation d'antenne (1010, 10105, 10108, 2010, 2030) soient mobiles dynamiquement l'une par rapport à l'autre pour ajuster une configuration du réseau d'antennes par entraînement de la portion de substrat dans la région de connexion (1020) en flexion.

2. Réseau d'antennes selon la revendication 1, dans lequel une couche spécifiée des au moins deux couches (2014, 2034) de la portion de substrat dans chacune des première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) et la portion de substrat (2020) dans la région de connexion (1020) sont constituées d'un matériau souple et connectées entre elles sous la forme d'une couche continue.

3. Réseau d'antennes selon la revendication 2, dans lequel l'autre des au moins deux couches (2012, 2018, 2032, 2038) de la portion de substrat dans chacune des première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) est constituée d'un matériau moins souple que la couche spécifiée des au moins deux couches (2014, 2034) pour l'installation sur celle-ci de la première/deuxième unité d'antenne (110, 1101 à 1109, 210, 212, 214).

4. Réseau d'antennes selon la revendication 1, dans lequel la portion de substrat dans la région de connexion (1020) est plus mince que la portion de substrat dans chacune des première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) de sorte qu'il reste un espace (2021) sous la portion de substrat dans la région de connexion (1020) entre les portions de substrat dans les première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030).

5. Réseau d'antennes selon la revendication 1, comprenant en outre une troisième unité d'antenne (1107/1108, 210/212) supportée par la même portion de substrat dans la première ou seconde région d'installation d'antenne (10108, 2010), et connectée mutuellement aux première et deuxième unités d'antenne (210/212, 214) par la ligne de transmission de signal (120, 220).

6. Réseau d'antennes selon la revendication 1, dans lequel la portion de substrat dans chacune des première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) est mise en œuvre avec une carte de circuit imprimé multicouche.

7. Réseau d'antennes selon la revendication 1, dans lequel la portion de substrat dans la région de connexion (1020) est mise en œuvre avec une seule ou de multiples couches diélectriques.

8. Système d'antenne, comprenant :

un réseau d'antennes (10) selon la revendication 1 ;
un dispositif de commande (3000, 3010) configuré pour déterminer une configuration du subs-

trat souple (100) selon un réglage par défaut ou en réponse à une entrée dynamique ; et un mécanisme d'entraînement (3100, 3110, 3200, 3300) connecté entre le substrat souple (100) et le dispositif de commande (3000, 3010) pour entraîner un changement de la configuration du substrat souple (100) en réponse à un ordre provenant du dispositif de commande.

9. Système d'antenne selon la revendication 8, dans lequel le dispositif de commande est en outre configuré pour déterminer un mouvement relatif entre la portion de substrat dans la première région d'installation d'antenne (1010, 10105, 10108, 2010, 2030) et la portion de substrat dans la seconde région d'installation d'antenne (1010, 10105, 10108, 2010, 2030) selon le réglage par défaut ou en réponse à l'entrée dynamique.

10. Système d'antenne selon la revendication 8, dans lequel le mécanisme d'entraînement (3100, 3110, 3200, 3300) est connecté aux portions de substrat dans les première et seconde régions d'installation d'antenne (1010, 10105, 10108, 2010, 2030) et au dispositif de commande (3000, 3010) pour entraîner le mouvement relatif en réponse à l'ordre provenant du dispositif de commande.

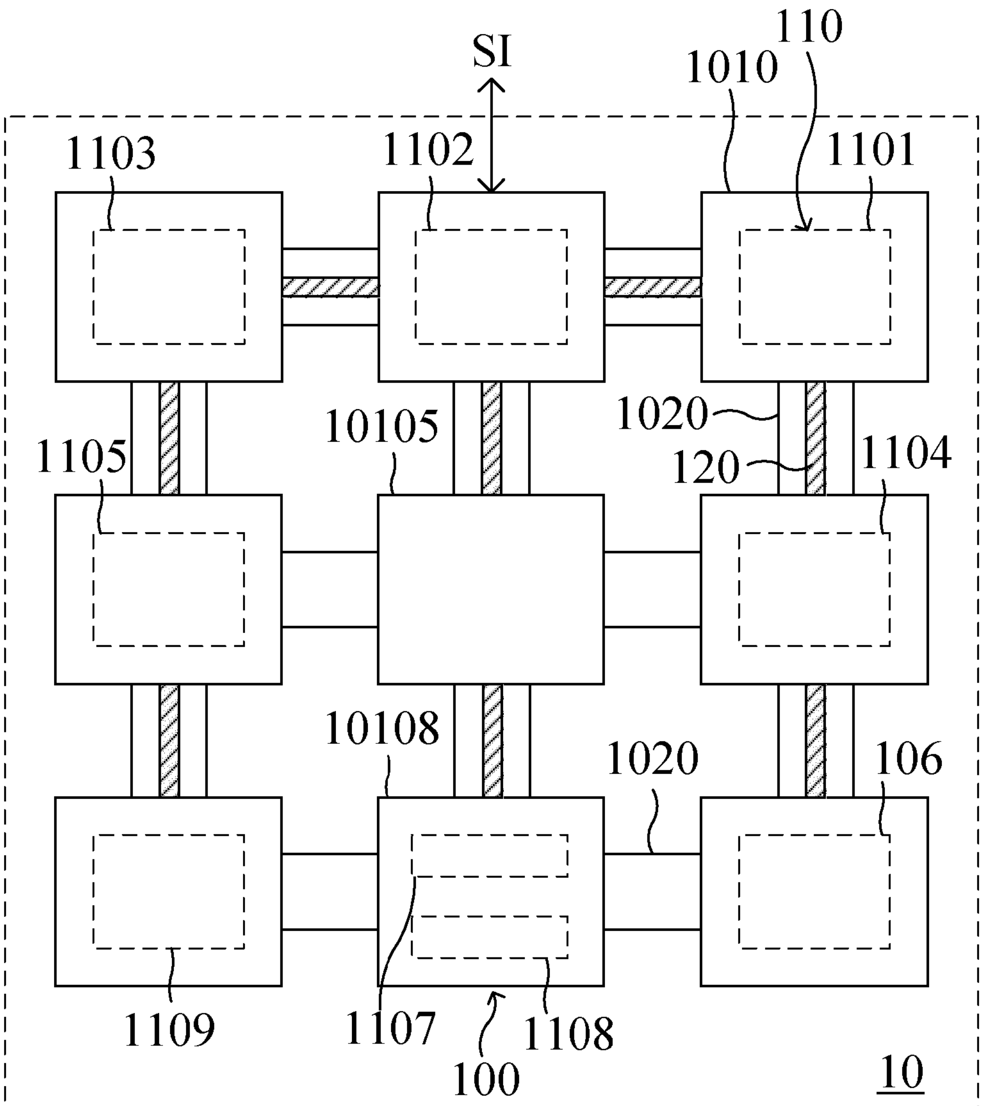
SI
110
1010
1103
1102
1101
1020
10105
1105
120
1104
10108
1020
106
1109
1107
1108
100
10

FIG. 1A

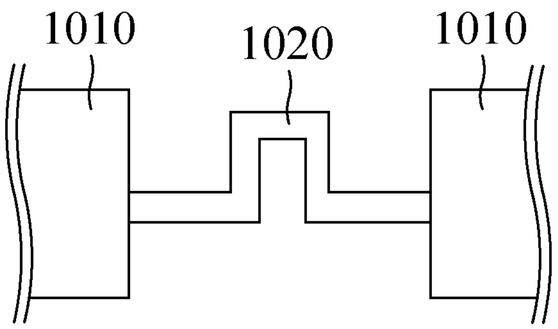
1010
1020
1010

FIG. 1B

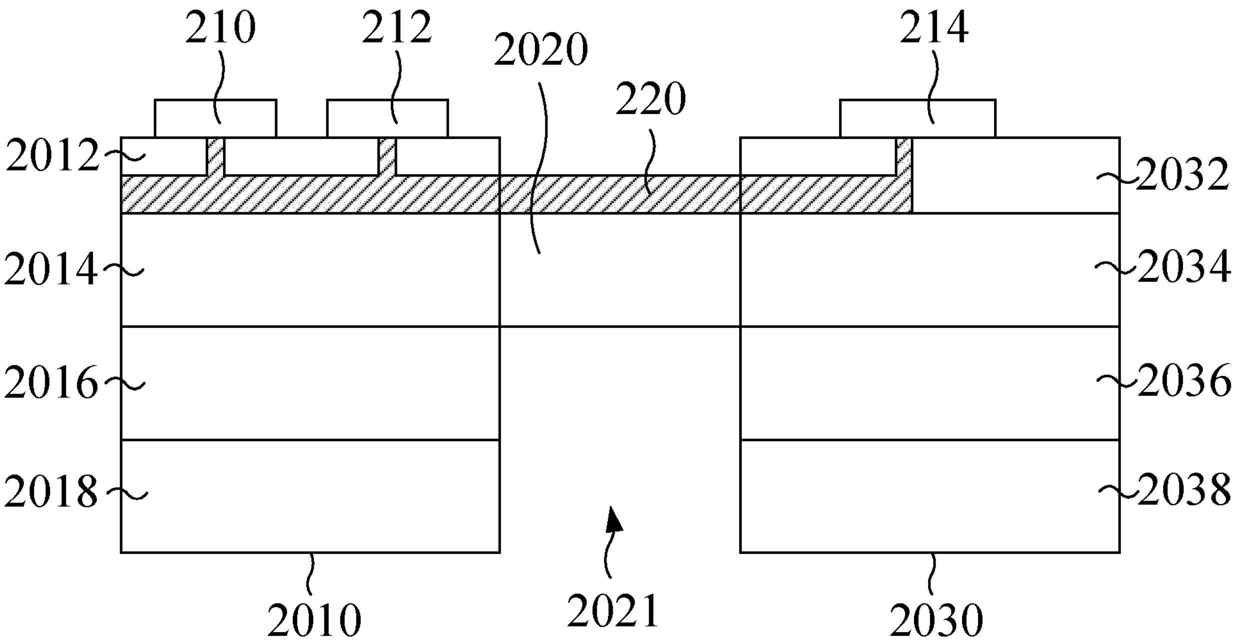
210
212
2020
220
214
2012
2032
2014
2034
2016
2036
2018
2038
2010
2021
2030

FIG. 2

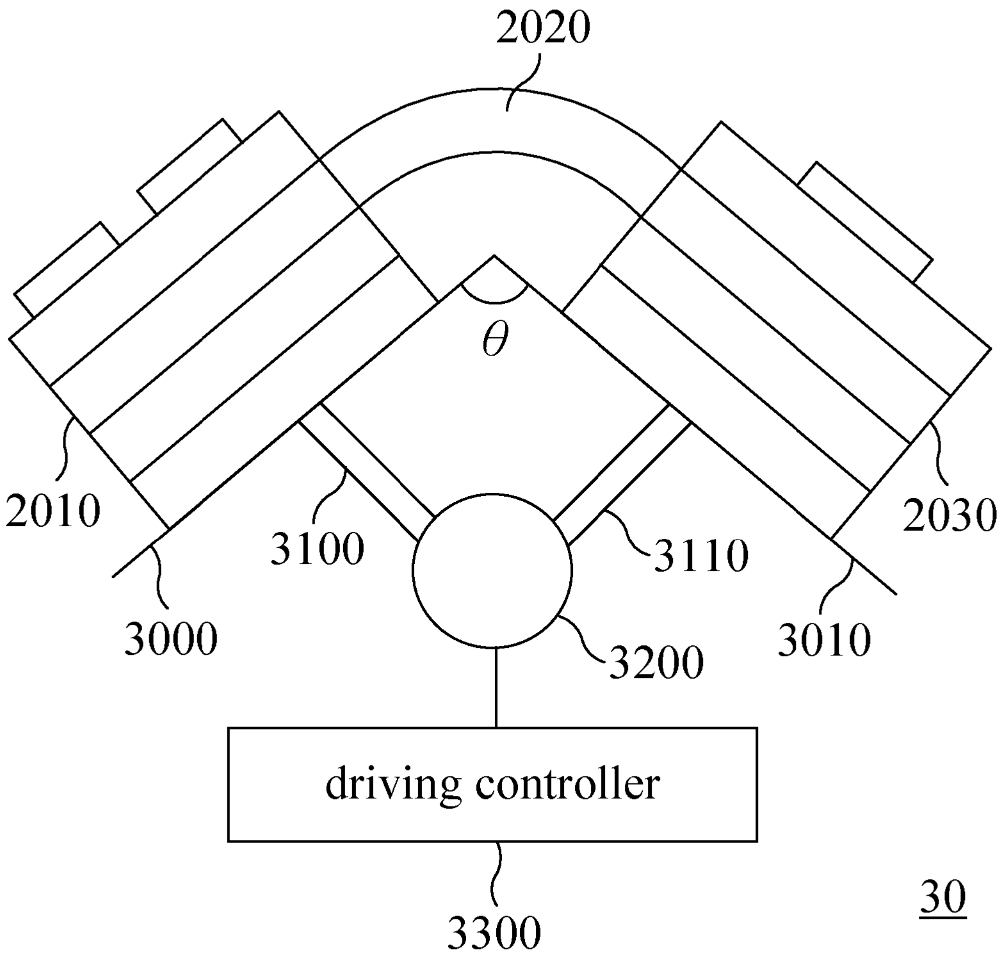
2020
θ
2010
3100
3110
2030
3000
3200
3010
driving controller
3300
30

FIG. 3

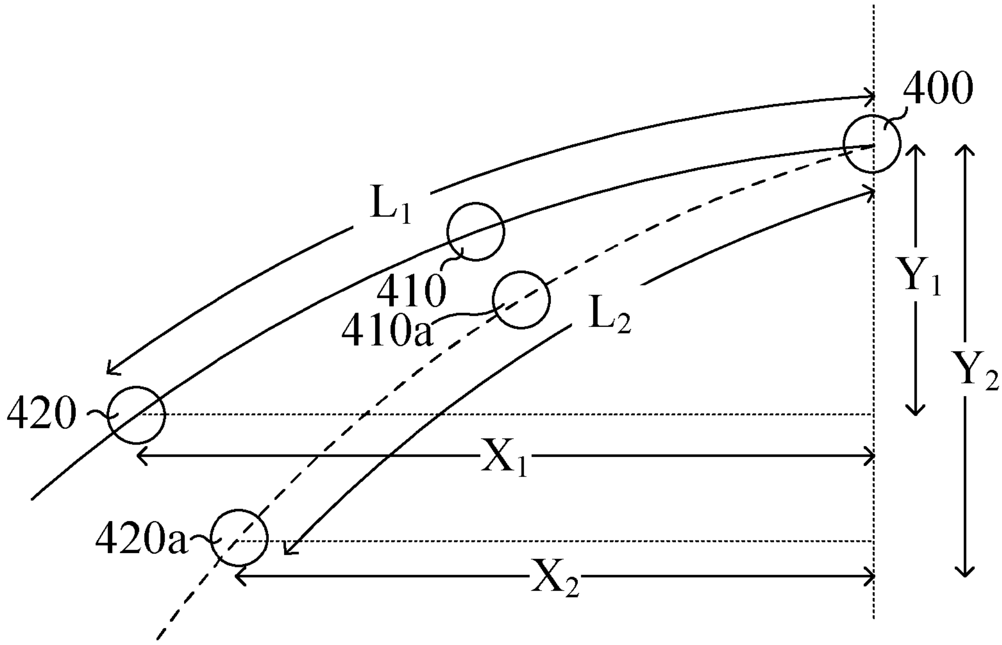

FIG. 4

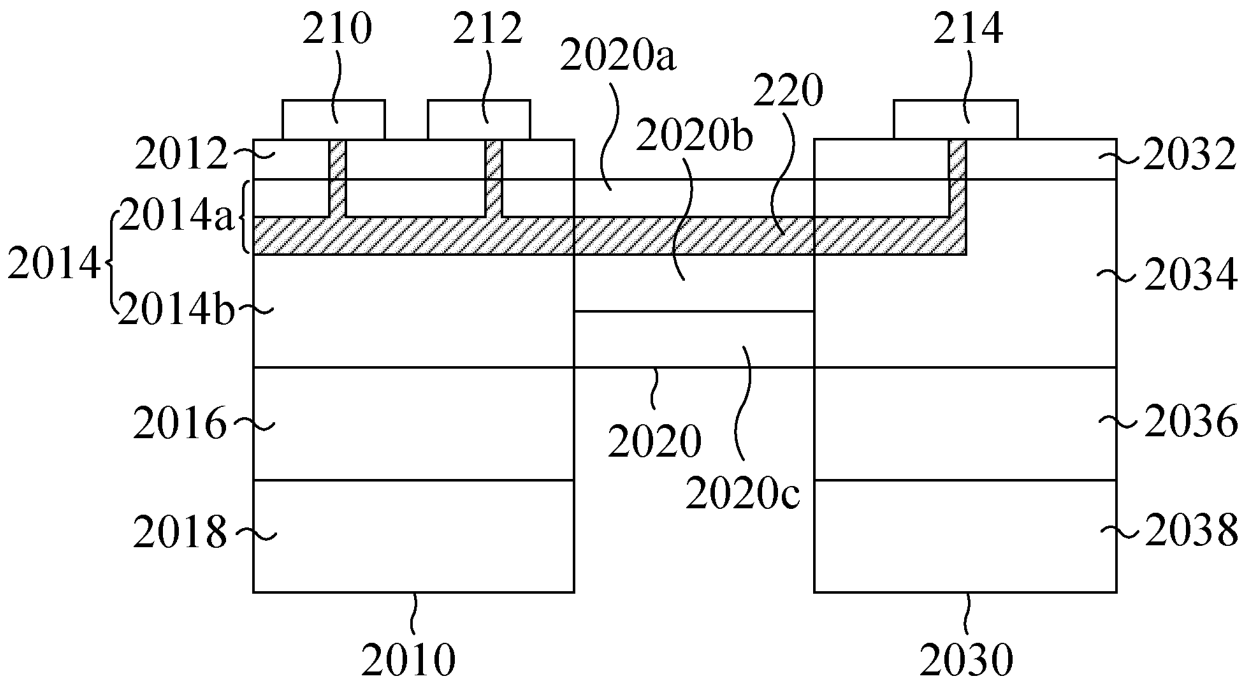
210
212
2020a
220
214
2020b
2012
2032
2014a
2014
2034
2014b
2016
2020
2036
2020c
2018
2038
2010
2030

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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