This application is further related to co-pending U.S. Non-provisional Patent Application entitled “Excitation and Use of Guided Surface Waves,” which was filed on June 2, 2015 and assigned Application Number 14/728,492, and which is incorporated herein by reference in its entirety.

BACKGROUND

[0003] For over a century, signals transmitted by radio waves involved radiation fields launched using conventional antenna structures. In contrast to radio science, electrical power distribution systems in the last century involved the transmission of energy guided along electrical conductors. This understanding of the distinction between radio frequency (RF) and power transmission has existed since the early 1900’s.

SUMMARY

[0004] Embodiments of the present disclosure are related to embedding data on a guided surface wave.

[0004a] According to a first aspect of the present invention, there is provided a system, comprising:

a guided surface wave receive structure configured to obtain electrical energy from a guided Zenneck surface wave traveling along a lossy conducting medium, wherein the guided Zenneck surface wave is launched by a guided surface waveguide probe and a phase delay of the guided surface wave receive structure is set to match a wave tilt angle associated with a complex Brewster angle of the lossy conducting medium in a vicinity to the guided surface wave receive structure; and

modulation circuitry configured to modulate an aggregate electric load coupled to the guided surface wave receive structure with reference to a data signal.

[0004b] According to a second aspect of the present invention, there is provided a method comprising:

setting a phase delay of a guided surface wave receive structure to match a wave tilt angle associated with a complex Brewster angle of a lossy medium in a vicinity to a guided surface wave receive structure;

receiving electrical energy in a form of a guided Zenneck surface wave using the guided surface wave receive structure;

supplying electrical energy to an electrical load coupled to the guided surface wave receive structure; and

modulating an aggregate electric load coupled to the guided surface wave receive structure with reference to a data signal, wherein the aggregate electric load is presented by the electrical load and a variable control load.

[0005] There is disclosed a system comprises a guided surface wave receive structure configured to obtain electrical energy from a guided surface wave traveling along a lossy conducting medium, where the guided surface wave is launched by a guided surface waveguide probe. Such a system further comprises modulation circuitry configured to modulate an aggregate electric load coupled to the guided surface wave receive structure with reference to a data signal.

[0006] In one embodiment, such a system further comprises a variable control load coupled to the guided surface wave receiving structure, where the aggregate electrical load is presented by at least the variable control load, in which the

aggregate electrical load is experienced as a load at an excitation source coupled to the guided surface waveguide probe generating the guided surface wave.

[0007] In one embodiment, the modulation circuitry for such a system is configured to modulate an impedance of the variable control load. In one embodiment, the modulation circuitry for such a system is configured to modulate a circuit drawing the variable control load between an open state and a closed state. In one embodiment, the aggregate electrical load for such a system is presented by the variable control load and an electrical load consuming power delivered by the guided surface wave. In one embodiment, the guided surface wave receive structure for such a system comprises at least one of a linear probe, a tuned resonator, or a magnetic coil.

[0008] In one embodiment, such a system comprises a current detection circuitry configured to detect a modulation in current of the guided surface waveguide probe. In one embodiment, the current detection circuitry for such a system is configured to sample the current to obtain an embedded symbol. In one embodiment, for such a system, the current is sampled to detect different current levels that correspond to different binary digits of the embedded symbol. In one embodiment, the current detection circuitry for such a system comprises an ammeter coupled to the guided surface waveguide probe. In one embodiment, such a system further comprises a filter accepting an output of the current detection circuitry.

[0009] There is disclosed a method comprises receiving electrical energy in a form of a guided surface wave using a guided surface wave receive structure;

supplying electrical energy to an electrical load coupled to the guided surface wave receive structure; and modulating an aggregate electric load coupled to the guided surface wave receive structure with reference to a data signal, where

the aggregate electric load is presented by the electrical load and a variable control load.

[0010] In one embodiment, such a method further comprises detecting a modulation in a current of a guided surface waveguide probe generating the guided surface wave. In one embodiment, such a method further comprises determining a symbol corresponding to at least a portion of the data signal, where the electrical load is modulated to effect a current state embodying the symbol. In one embodiment, for such a method, the current state comprises an amplitude state.

[0011] In one embodiment, the guided surface wave receive structure for such a method comprises at least one of a linear probe, a tuned resonator, or a magnetic coil. In one embodiment, for such a method, modulating the aggregate electrical load comprises modulating an impedance of the variable control load. In one embodiment, for such a method, the modulating of the aggregate electrical load comprises modulating a circuit drawing the variable control load between an open state and a closed state.

[0012] There is disclosed a method comprises transmitting electrical energy in a form of a guided surface wave using a guided surface waveguide probe; detecting a modulation in current of the guided surface waveguide probe; and sampling the current to obtain an embedded symbol.

[0013] In one embodiment, for such a method, the current is sampled to detect different current levels that correspond to different binary digits of the embedded symbol.

[0014] Other systems, methods, features, and advantages of the present disclosure will be or become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional

CLAIMS

Therefore, the following is claimed:

1. A system, comprising:

a guided surface wave receive structure configured to obtain electrical energy from a guided Zenneck surface wave traveling along a lossy conducting medium, wherein the guided Zenneck surface wave is launched by a guided surface waveguide probe and a phase delay of the guided surface wave receive structure is set to match a wave tilt angle associated with a complex Brewster angle of the lossy conducting medium in a vicinity to the guided surface wave receive structure; and

modulation circuitry configured to modulate an aggregate electric load coupled to the guided surface wave receive structure with reference to a data signal.

2. The system of claim 1, wherein the aggregate electric load comprises an electric load coupled in parallel with a variable control load, wherein the variable control load is further coupled to a switch that is capable of being switched between an open state and an closed state, wherein an impedance of the variable control load is varied by activation of the switch.

3. The system of claim 2, wherein the modulation circuitry is configured to modulate the impedance of the variable control load.

4. The system of claim 2, wherein the modulation circuitry is configured to modulate a circuit drawing the variable control load between the open state and the closed state.

5. The system of claim 2, wherein the aggregate electrical load is presented by the variable control load and an electrical load consuming power delivered by the guided Zenneck surface wave.

6. The system of claim 1, further comprising a current detection circuitry configured to detect a modulation in current of the guided surface waveguide probe.

7. The system of claim 6, wherein the current detection circuitry is configured to sample the current to obtain an embedded symbol.

8. The system of claim 7, wherein the current is sampled to detect different current levels that correspond to different binary digits of the embedded symbol.

9. The system of claim 6, wherein the current detection circuitry comprises an ammeter coupled to the guided surface waveguide probe.

10. The system of claim 6, further comprising a filter accepting an output of the current detection circuitry.

11. The system of claim 1, wherein the guided surface wave receive structure comprises at least one of a linear probe, a tuned resonator, or a magnetic coil.

12. A method comprising:

setting a phase delay of a guided surface wave receive structure to match a wave tilt angle associated with a complex Brewster angle of a lossy medium in a vicinity to a guided surface wave receive structure;

receiving electrical energy in a form of a guided Zenneck surface wave using the guided surface wave receive structure;

supplying electrical energy to an electrical load coupled to the guided surface wave receive structure; and

modulating an aggregate electric load coupled to the guided surface wave receive structure with reference to a data signal, wherein the aggregate electric load is presented by the electrical load and a variable control load.

13. The method of claim 12, further comprising detecting a modulation in a current of a guided surface waveguide probe generating the guided Zenneck surface wave.

14. The method of claim 12, further comprising determining a symbol corresponding to at least a portion of the data signal, wherein the electrical load is modulated to effect a current state embodying the symbol.

15. The method of claim 14, wherein the current state comprises an amplitude state.

16. The method of claim 12, wherein the guided surface wave receive structure comprises at least one of a linear probe, a tuned resonator, or a magnetic coil.

17. The method of claim 12, wherein modulating the aggregate electrical load comprises modulating an impedance of the variable control load.

18. The method of claim 12, wherein the modulating of the aggregate electrical load comprises modulating a circuit drawing the variable control load between an open state and a closed state.