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Magnetic Virtual Transmission Lines for Communication and Power Transfer in Conducting Media

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Electrical loops are normally constructed as either dipoles or metal loop antennae. Magnetic loop antennae act as magnetic dipoles and dissipate less heat into the surrounding media, making them somewhat better suited for applications where the electrical loops are surrounded by conductive materials. Unfortunately, loop antennae are less efficient than dipoles, so to attain a desired amount of power they must carry large current. Carrying such large current necessarily results in increased losses of energy in the form of heat dissipating through the surrounding media. When operating in conductive fluid media, antennae are able to store significantly more energy than they can radiate, so enormous amounts of energy are lost because of an inability to effectively transfer energy from one antenna to another. This is a particular problem since all realistic media are conductive.

Researchers at Arizona State University have invented a method of configuring an antenna system from a chain of physically disconnected but mutually coupled resonant magnetic dipoles (as opposed to electric dipoles, described above). These dipoles minimize the dissipation of energy into the surrounding media and allow the energy to spread along the full length of the antenna system. Increasing the available length over which energy can flow improves efficiency. These antennae can be used as a true magnetic dipole radiating with the use of true magnetic current. Power can be transmitted wirelessly through a chain of antennae. Instead of radiating heat outwards, the system guides heat from one element of the system to another.

Potential Applications

- Neuroscience (measurement of brain waves)
- Energy transfer
- Wireless communication
- True magnetic current radiators

Benefits and Advantages

- Rugged – Able to automatically re-rout the energy transfer should one or several antenna- elements in the chain become inoperable
- Efficiency – Less energy is lost from the system as heat, resulting in an overall lower energy requirement.
- Versatility – The system does not let off large amounts of heat, so the dipole loops can be incorporated into an expanded range of applications.

For more information about the inventor(s) and their research, please see

Dr. Rodolfo Diaz's directory webpage

For more information about related technologies, please see

M13-240P: Procedure for designing conformal antennas with maximized efficiency bandwidth product