

Through-Ice Antenna for Extreme Environments

In the challenging environment of research under the Arctic Ocean, satellite communication of unmanned vehicles is hindered by sea ice's dissipative properties. This technology is capable of transmitting data from these unmanned vehicles, through the ice, and to the satellite. It is built to be compact, durable, and customizable to the frequency range required.

What is the Problem?

The conditions of the Arctic Ocean are of interest both to researchers studying the changing climate and Arctic oceanography as well as those working in polar marine shipping and offshore construction. Unmanned underwater vehicles (UUVs) equipped with sensors can collect such information on the conditions of the ocean and are designed to relay that information through a satellite. However, if the ocean surface is covered in ice, typical satellite communication wavelengths in the microwave range will not be able to penetrate through.

Some methods do exist to circumvent this, but these require the use of a repeater on the surface of the ice to convert a signal that can penetrate the ice into a signal that can be sent to the satellite. There is still an unmet need in the design of an antenna system for a UUV that can withstand harsh conditions such as the Arctic Ocean without the need of extra equipment.

What is the Solution?

A radio frequency antenna is designed such that when placed against sea ice, the signal can penetrate the ice and reach the satellite with sufficient bandwidth. The antenna design is optimized to minimize the losses of traveling through the ice, and a vertically oriented wave guide is included so that the UUV does not risk colliding with the surface ice. The properties of the antenna material are selected to align with that of seawater, allowing peer to peer UUV communication, and the overall design is made to be compact and robust against the harsh conditions of the Arctic Ocean.

What is the Competitive Advantage?

This system is built to be tough, adaptable, and easy to integrate into a UUV or other sensing system. The antenna materials are chosen to allow for a compact, durable design, with no additional equipment (such as surface repeaters) required. The frequency of the system is customizable, all while delivering a high bandwidth. The antenna signal can penetrate not only sea ice, but other challenging media as well, including ground (soils, dirt) and thick walls (bricks, concrete).

Technology ID

BDP 8804

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