An Underwater Electromagnetic Localization from Ice Surface

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Autonomous underwater vehicle (AUV) surveys under the ice in the Arctic and Antarctic are an important issue but no one had carried out surveys all over there with accurate positioning anywhere until now. We would like to propose an under-ice localization system for underwater platforms including AUVs. It is a short range positioning system (SPS) using electromagnetic (EM) waves, consisting of a land unit put on the ice surface and an underwater unit installed on an AUV. The SPS is used low frequency EM waves which can propagate between sea ice and sea water. A land unit of the SPS set on the ice receives GPS signal, identifying self-location. It transmitting EM waves into the sea water through the ice up to several tens meters deep as a reference position. This service range is very small for AUVs. In order to overcome the drawback, we use the benefit of a Doppler velocity log (DVL)-inertial navigation system-hybrid which has very small position error of about a few meters for a kilometer as long as bottom tracking of the DVL is available. If cruising range of an AUV is 100 km, we keep the distance of each land unit of the SPS as 10 km within the range.

To realize the system feasibility we started development and optimization of underwater antennas and measuring wave propagation in the sea ice and the sea water in 2016. Optimal underwater antenna types in each frequency band from LF to HF have studied and simulation of propagation in air-accumulated snow - sea ice - sea water boundary has been performing. In March 2018 we carry out a practical test for ice surface to sea water propagation and communication in Saroma Lake, Hokkai-do, Japan. In the conference we would like to report our achievement of basic study for the SPS system including the results of the practical test.

Keywords: underwater localization, underwater electromagnetics, under the sea ice, AUV