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Development of an Optical Underwater Communication Model.

ABSTRACT - Masterthesis

Water covers most part of our earth. Some scientists say that we know more about the space, planets and universe than about processes happens inside the depths of earth oceans. This part of our planet is mostly unknown and need to be investigated. Understanding of our planet helps us to use the resources of the planet in more proper way and to live in synergy with the nature and other species.

Underwater world is more difficult to investigate than it seems to be at first. Missing air in that form people need it and high pressure in deep ocean make this place dangerous for people, additionally the water temperature in deep regions of ocean is around four degree. Therefore people rely on new technologies which can help to survive in this dangerous surrounding or at least minimize the risk.

One of this new technology is an optical underwater communication. Optical communication is well known technology area, it is widely use for data transmission via optical fiber. Optical fiber connecting continents and allows not only an easy communication but also a possibility to transmit a big amount of data. Several of this optical fibers connecting Europe with North America are placed on the ground of Atlantic Ocean. Optical signals are also used to transmit data via air channel, distance which can be covered by such technology is enormous big and according to the transmitted bandwidth and power of the light source can cover hundred thousands of kilometres. One of the famous examples of that is the measurement of distance to moon. Big laser targeted on a special place on moon where astronauts placed reflectors send signal, system measures the light travel time and according to that the distance to moon which is 356700 kilometres can be calculated. The scientists figure out that moon slightly remove form the earth with the range of 3.8 cm per year, this example shows how precise optical measurements could be. Therefore the next logical step is to bring optical communication underwater.

The communication underwater is based at the time an acoustical waves, which have the major disadvantage in there bandwidth limitation. Next disadvantage is that acoustical signal can be received by everyone because this system works not punctual and have a very big range. Acoustical signal can travel a long distance, the longest distance were around 8000 km, what means that everyone who is in travel direction can receive this signal.

Optical communication would make that kind of communication more safety. This signal could be directly transmitted to the receiver. Other advantage of optical underwater communication is the high bandwidth which can be used to transmit a big amount of data. This just collected data by AUV but also signals to control position of AUV. Such experiment were already done by MIT University where several underwater vehicles could be arrange themselves in a swam and interchange there data and position.

However optical underwater communication faced with there own issues, for example the absorption of infrared light which is widely used in fiber optics is enormous and not real appropriate for underwater communication instead the wavelength of $\lambda = 532$ nm is suitable for data transmittance. Big amount of organic material but also sediment particles and air bubbles can disturb optical signal and decrease there range. The earth curvature is an additionally issue which need to be solved before optical signals can cover a long ranges. All this issues need to be preciously solved before underwater optical communication can be used in the same manner like it already done for fiber optics or for optical air transmittance.