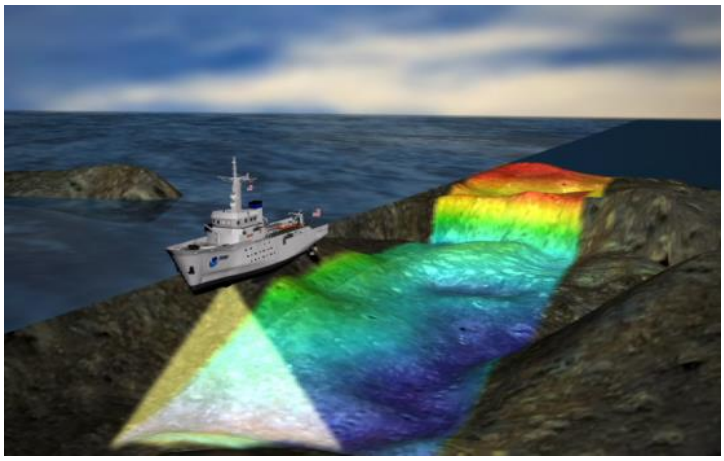
Instant SAS: computationally efficient synthetic aperture SONAR

Introduction

Oceans and seas are more and more exploited by humans, bringing along an increasing need for building and construction in maritime environments. In order to enable such activities some sort of vision is needed to create awareness of the environment. Vision under water can be realized by optical and acoustical systems. In this study we focus on the use of acoustics for vision, which is generally known as SONAR imaging.



Modern high-frequency SONARs are capable of producing high-quality images of the sea bottom. As long as objects of interest lay proud on the sea bottom this imaging technology works well. In many occasions, however, the undersea conditions are less favorable and objects may have sunken into the sediment. This is particularly a problem if these objects are, e.g., explosives that may be dangerous for fishery or sub-sea construction. Since high-frequency SONAR does not penetrate into the bottom, such objects are invisible for this type of sonar. Fortunately, low-frequency sound is capable of penetrating into the bottom and therefore capable of detecting sunken objects.

TNO has developed a wideband low-frequency synthetic aperture SONAR to exploit the useful properties of low-frequency underwater sound. This type of SONAR allows the user to create images of the inside of the sea bottom. The computational burden of low-frequency wideband synthetic aperture imaging technology is high, because all movements of the SONAR have to be taken into account during the imaging process. Consequently, the imaging process takes a long time. In order to create an immediate situational awareness, there is a need to dramatically improve the computational speed of this type of synthetic aperture SONAR processing.

Assignment

The purpose of this assignment is to investigate methodologies and computer architectures to implement (near) real-time high-quality synthetic aperture SONAR processing. The assignment consists of:

- Build an understanding of the low-frequency synthetic aperture SONAR imaging process
- Study currently used algorithms for high-quality imaging
- Study computer architectures for (near) real-time image processing
- Develop system-level designs for potential (near) real-time SONAR processing and make a trade-off of between the designs
- Design and implement the most viable approach
- Establish a metric for benchmarking the high-speed implementation with currently used techniques
- Conduct an evaluation of the achievements

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