BIO-SONAR SIGNAL PROPAGATION MODELLING IN HETEROGENEOUS MEDIA WITH FDTD METHODS

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Modelling of acoustic waves in heterogeneous media with finite differences is a useful tool for a number of disciplines providing a complete description of the acoustic field. However, these models are limited by their accuracy, stability, dispersion and grid dimension. These parameters depend mostly on the order and the dispersion properties of the chosen method. However, there are no specific guidelines to choose the right method in advance; therefore prior analysis is often needed.

is paper, we focused on the behaviour of an acoustic wave passing trough heterogeneous media simulating biological tissues and studied the response of this wave depending on the angle of incidence from one medium to another. We also compared the results of 4th and 2nd order finite difference schemes simulating this scenario. Interestingly, the latter was never tested in a similar environment, while the first brought successful results.

RANGE DETECTION OF SPERM WHALE SONAR

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There has been much speculation about the sperm whale sonar capabilities. While the usual clicks of this species are considered to support the mid-range echolocation, no physical characteristics of the signal have clearly confirmed this assumption nor have explained how sperm whales forage on squids. The recent data on sperm whale on-axis recordings have allowed us to simulate the propagation of a 15kHz pulse as well as its received echoes from different targets taking into account the reflections from the bottom and the sea surface. The analysis was performed in a controlled environment where the oceanographic parameters and the acoustic background could be modified. We also conducted experimental measurements of squid target strength (Loligo vulgaris and Sepia officinalis) to further investigate and confirm the TS predictions from the geometric scattering equations. Based on the results of the computer simulations and the TS experimental measurements, we were able to determine the sperm whale sonar minimum requirements, i.e. range and directional hearing, to locate a single 24,5cm long squid, considered from stomach contents to be the major component of its diet. Here, we present the development of the analysis which confirms that sperm whale usual clicks are appropriate to serve a mid-range sonar function allowing them to forage on individual low sound-reflective organisms.