ELASTIC TARGET MODELING FOR PHYSICS-BASED AUTOMATIC CLASSIFICATION

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Sonar interrogation of elastic targets such as UXOs provides rich information for automated classification, but much of the basic physics knowledge of acoustic-structure interaction has not found its way into current classification systems which rely on generic feature sets and classification algorithms. Returns from a particular target class can vary widely depending on the orientation and burial state of the target, as well as the sediment type and sonar incidence angle. As a result, system training and development relies on collecting large data sets from a wide variety of conditions. With such an approach, there is no guarantee that the initial data representation is ideal for the target/non-target separation or that the system will be robust in new environments. Even if a sufficiently representative dataset could be collected, the decision boundary across all the above variables may exceed the complexity of the chosen classification algorithm to learn. We have been developing a finite element (FE) modeling approach with a goal of isolating classes of physical mechanisms contributing to the complex sonar return, and relating these classes to the structure of the target. We begin by analyzing the model of the internal structure during acoustic interrogation, and use the results to apply constraints to the physics model to isolate the portion of the return due to particular classes. In isolation, we can then study the effects of burial and source/target position on the manifestation of each class of observable features