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Concurrent detection, classification and localization of seabed targets using virtual time reversal

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During the last decade, the use of unmanned vehicles to detect seabed objects has been revolutionized by the rapid development of AUV technology. The reduced power budget imposed by autonomous operations limits the amount of processing allowable onboard and calls for simple and efficient detection algorithms. Time reversal techniques have proved to be a robust way of focusing sound on reflective objects in complex environments and only require minimal computation. The method proposed here uses a virtual time reversal mirror in monostatic configuration to localize the origin of the field scattered by objects located on the seafloor. The waveguide is insonified with a low frequency source (∼kHz) mounted on the AUV and the resulting scattered field is sampled by a receiving array towed behind the vehicle. The recorded signals are then used to simulate the time reversed transmissions onboard, generating a map of reflectors present on the seabed. The rejection of clutter using singular value decomposition and the sensitivity of this method to environmental misknowledge are addressed along with the presentation of experimental results. [Work supported by ONR]