A Method to Solve an Acoustic Scattering Problem Involving Smart Obstacles

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In the context of time harmonic acoustic scattering we formulate an Inverse problem involving smart obstacles and we propose a method to solve it. A smart obstacle is an obstacle that when hit by an incoming acoustic wave tries to pursue a given goal circulating a suitable pressure current on its boundary. A pressure current is a quantity whose physical dimension is pressure divided by time.

The goals pursued by the smart obstacles that we have considered are the following ones: to be undetectable or to appear with a shape and/or acoustic boundary impedance different from its actual ones eventually in a location in space different from the actual location. We fix our attention on obstacles that pursue the goal of being masked that is obstacles that try to appear with a shape and an acoustic boundary impedance different from their actual ones. As a special case of masked obstacles we consider the case of furtive obstacles, that is obstacles that try to be undetectable.

We consider the following time harmonic inverse scattering problem: from the knowledge of several far fields generated by the smart obstacle when hit by known time harmonic waves, the knowledge of the goal pursued by the smart obstacle and of its acoustic boundary impedance reconstruct the boundary of the obstacle.

A method to solve this inverse problem that generalizes the so called HERGLOTZ function method used in inverse obstacle scattering is proposed. This method is based on the definition of two HERGLOTZ functions, one for the acoustic field scattered by the smart obstacle and one associated to the pressure current through an auxiliary variable. Under some hypotheses the HERGLOTZ functions are determined from the knowledge of the far fields. The knowledge of the HERGLOTZ functions makes possible the reconstruction of the boundary of the smart obstacle using ad hoc equations. Two numerical experiments that validate the method proposed are presented.

The website http://www.econ.univpm.it/recchioni contains a general overview of the work on scattering done in the past years.