Characterisation of Multiple Conducting Permeable Objects in Metal Detection by Polarizability Tensors

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Locating and identifying hidden conducting objects has a range of important applications including searching for buried treasure, identifying landmines and in the early detection of concealed terrorist threats. Traditional approaches to the metal detection problem involve determining the conductivity and permeability distributions in the eddy current approximation of Maxwell's equations and lead to an ill-posed inverse problem. On the other hand, practical engineering solutions in hand held metal detectors use simple thresholding and are not able to discriminate between small objects close to the surface and larger objects buried deeper underground.

In this talk, an alternative approach, in which prior information about the form of the conducting object has been introduced, will be discussed. Previous work has allowed the perturbed magnetic field, due to the presence of a single conducting (permeable) object with homogeneous coefficients, to be described by asymptotic expansion as the size of the object tends to zero [1,2.3]. The asymptotic expansion allowed the object's shape and material parameters to be described by a magnetic polarizability tensor (MPT), which is independent of the object's position. This talk will focus on our recent extension to the the treatment of multiple conducting permeable objects and present new results for the perturbed magnetic field in terms of MPTs when the objects are closely spaced and when they are sufficiently well separated [4]. We will also describe the case of the magnetic field perturbation caused by the presence of an inhomogeneous conducting permeable object in terms of an MPT.

These results of are of practical importance since metal detection practitioners routinely need to locate and distinguish between multiple (inhomogeneous) conducting objects.

References:

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