

Transient Adaptive Polarization-Contrast Imaging Algorithm for Through-Wall Detection of Objects inside the Room

Konstantin M. Yemelyanov⁽¹⁾, John A. McVay⁽²⁾, Ahmad Hoorfar⁽²⁾, N. Engheta⁽¹⁾

(1) University of Pennsylvania, Department of Electrical and Systems Engineering, Philadelphia, PA, 19104, USA

(2) Villanova University, Department of Electrical and Computer Engineering, Villanova, PA, 19085, USA

Through-wall microwave imaging (TWMI) has various applications in civilian and defense scenarios. In our research group we design, fabricate, and test a portable TWMI system that would be able to collect the scattered electromagnetic field from the object located behind the wall, as well as we develop electromagnetics and signal processing algorithms to process that data in order to identify and classify the objects behind the wall of different types. One of such techniques is Transient Adaptive Polarization-Difference Imaging (TAPDI) algorithm which is the further extension of APDI algorithm previously reported by our group (K. M. Yemelyanov, J. A. McVay, N. Engheta, A. Hoorfar, "Adaptive Polarization-Difference Imaging Algorithms for Through-the-Wall Microwave Imaging Scenarios," *Proc. IEEE AP-S Int. Symposium*, pp. 114–117, July 2005). In our most recent work (K. M. Yemelyanov, J. A. McVay, N. Engheta, A. Hoorfar, "Transient Adaptive Polarization Contrast Techniques in Time-Domain Scattering with Applications in Through-Wall Microwave Imaging," XXVIII-th General Assembly of URSI, New Delhi, India, October 23-29 2005) we presented the modification of APDI algorithm in the Time Domain (TAPDI) and showed its applications for target detection behind the wall.

In the present study we are planning to apply the TAPDI technique to more complex TWMI scenes, using numerically computed scattered fields, as well as to actual measured data, i.e. scattered field from real objects (subject to availability of the TWMI system which is currently being finalized). This will check and verify this algorithm and its range of applicability. Another important aspect of the TAPDI we are currently working on is the technique to discover the presence of interior walls behind the exterior walls (the wall separating TWMI system from the observing scene). In other words the ideal goal will be to obtain an approximate floor plan of the building. In this work we initiate the research in this area and present initial simulations for several room scenarios. We will test the algorithm for both detection of extra walls and objects in the scene.

In this work, we will present preliminary results and will discuss both above-mentioned aspects of the project.