Detection of Cracks in Composite Materials Through Factorization Method

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Microwave detection of cracks within composite materials is a difficult subject of non-destructive research with many important applications especially in aviation industry. Deformations in aircraft components due to aging or other reasons reduce the aircraft lifetime and more importantly, threaten the passengers safety. Even if there are a lot of studies for the detection and imaging of the deformations in layered structures like composite materials found in aircrafts, there is still need of higher resolution techniques to image such deformations for its relatively high economical and humanitarian consequences.

In this context, we consider the application of a specific form of linear sampling method, factorization method in conjunction with interior transmission eigenvalues for testing of aircraft fuselage. We restrict our analysis to 2D configuration i.e. a layered composite structure which is unchaining in one direction is illuminated by a system of antennas from the accessible sides and the scattered field is measured with the same antennas. As a qualitative inverse scattering method, factorization method can reconstruct the boundary of the deformation without a-priori information about the boundary conditions; however the quality of the reconstructions is highly dependent on the measurement configurations. That's why we have investigated several possible measurement settings and source excitations up to 40 GHz to uncover both possibilities and limitations of the factorization method for non-destructive testing purposes. Preliminary numerical results indicate that factorization method can be an effective alternative to existing methods. The findings will be given during the presentation.