# TIME DOMAIN MAGNETIC INDUCTION AND ELECTRIC FIELD TOMOGRAPHY

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The magnetic induction tomography (MIT) [1, 2] is electrical impedance imaging method in which alternating magnetic field is used for the probing of conductive (biological) object. The useful signals origin from the eddy currents exited in the conductive media by the time varying external magnetic field. The electric field tomography (EFT) exploits alternating electric field which is applied to the object under investigation without electrical contact with it. The useful signals are secondary electric fields appearing due to redistribution of the free charges inside the object (Maxwell-Wagner relaxation) [3, 4].Traditionally both methods wereanalyzed and implemented using frequency domain approach, i.e. initial and perturbed fields are periodic (sinusoidal) with given frequency $\omega$. In both methods the perturbation of the signal which brings information about object is small and is in quadrature to the excitation signal, so measurements of the phase shifts of the perturbed signals are necessary and sufficient for the imaging. Alternatively interaction of the probing signals with conductive media can be considered in time domain as time delays caused by the objects. The useful information is contained in varying of such time delays for different transmitter-receiver pairs. We have investigated such time domain approach for MIT and EFT using numerical simulation with FDTD method. Gaussian shaped pulses were used as excitation signals. In case of MIT and non-dispersive homogeneous conductive medium, the frequency domain analysis shows linear increase of the phase shift with frequency. In the time domain this means that pulsed signal keeps its shape and isjust delayed by the medium. The shape of pulse can be distorted by the large object however in some asymmetric configurations due to different propagation time inside and outside of the inhomogeneity. The situation is even more complex in the EFT where phase shift caused by Maxwell-Wagner relaxation always depends on frequency, and the pulse shape is always distorted by themedium.Results of simulation demonstrate these features, and the pulse shape distortion can be used as additional information about the object.Data collected with the time domain measurements can be utilized for image reconstruction using the all previously developed reconstruction algorithms. In particular, the filtered back-projection along unperturbed field lines is good choice even for large conductive volumes with low-contrast inclusions. It was pointed out inearlierpublications[5] that geometry of sensitivity zones in MIT is changed significantly in such environment, and this simple back-projection algorithm may be inapplicable. In fact the conductive background influences the weighting factor of the back-projection procedure, but not the geometry of the projection lines both in MIT and EIT. This is demonstrated by comparison of the dependences of delays (phase shifts in frequency domain) on the object position when receiver is fixed and on position of the receiver when the object is fixed.In real experiments the time domain measurements can be implemented using sample-and hold circuits, what is shown by SPICE simulation.Recent advantages in UWB technologies and components make this approach reasonable.

## References

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