

MEDICAL DIAGNOSTICS BASED ON MEASUREMENT OF COMPLEX PERMITTIVITY

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The measurement of dielectric parameters of biological tissue is a promising method in the medical imaging and diagnostics. Knowledge of the complex permittivity in a treated area, i.e. knowledge of complex permittivity of healthy and tumor tissues, is very important for example in diagnosis of tumor cell-nest in medical diagnostics or for engineers for the design of thermoterapeutic applicators. Also a very interesting is 3D reconstruction methods based on the layered uniform tissue model (skin, fat and muscle). There are several measurement methods for measuring dielectric properties. If we want to use broadband measurement method which is nondestructive, noninvasive and which can offer possibilities for in vivo and as well as in vitro measurements, we should choose reflection method on an open ended coaxial line.

In our study we consider dielectric measurements using a coaxial probe and network analyzer. The measurement consists of three steps. The first is the classical calibration of the network analyzer by calibration standards, the second the determination of values of elements in equivalent circuit by a reference material with known dielectric parameters, and finally measurement of the material with unknown dielectric parameters. The goal of the project is to verify the well known reflection method on an open ended coaxial line in the frequency range of the network analyzer, i.e. from 300 kHz to 3 GHz.

By modifying the standard N connector, from which the parts for connecting to a panel were removed, we developed the measurement (coaxial) sensors. The sensors are modelled by an equivalent circuit with lumped elements - fringe capacitance and radiating resistance. The radiating electromagnetic field of the probe and the behaviour of the lumped elements at higher frequencies for given geometry and dimensions of coaxial probe was under investigation. The objective of comparing measured reflection coefficient, admittance of coaxial probe respectively, with calculated admittance of equivalent circuit was optimization of the number of elements in this equivalent circuit and also the optimization of their values in view of better approximation of a measured curve.