Abstracts

Analysis of Focusing of Pulse Modulated Microwave Signals Inside a Tissue Medium

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The possibility to achieve focusing in a three-layer cylindrical biological tissue model, by using a large number of concentrically placed waveguide applicators and pulsed signals (~1 ns pulse width) with a high frequency (9.5 GHz) carrier is examined rigorously. The medium response to time harmonic excitation of the array is predicted, by solving the associated boundary value problem. To this end, the fields inside the tissue layers are expressed as integrals of vector cylindrical waves, satisfying the corresponding wave equations, while the fields inside the waveguides are expanded in terms of the guided and evanescent normal modes. By imposing the appropriate boundary conditions, a system of coupled integral equations is derived on the waveguide apertures, which is solved by expressing the unknown electric fields in terms of the waveguide modes and by applying a Galerkin procedure. Then, the medium response to pulse modulated excitation of the array elements is considered and the time dependence of the electromagnetic fields produced at any point within tissue is obtained in the form of an inverse Fourier integral. Numerical results are computed and presented at several points in a three-layer geometry, 20 cm in diameter, irradiated by a 30-element waveguide array and the use of time coincidence and constructive phase interference principles is examined, in order to achieve focusing at a specific point of interest within tissue.

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