Abstracts

Use of PML absorbing layers for the truncation of the head model in cellular telephone simulations

G. Lazzi, O.P. Gandhi and D.M. Sullivan. "Use of PML absorbing layers for the truncation of the head model in cellular telephone simulations." 2000 Transactions on Microwave Theory and Techniques 48.11 (Nov. 2000, Part II [T-MTT] (Special Issue on Medical Application and Biological Effects of RF/Microwaves)): 2033-2039.

An efficient implementation of the perfectly matched layer (PML) boundary has been used to truncate a 3-mm resolution head model used for cellular telephone simulations. An extensive analysis of the model truncation effects along all three axes has been performed. A basic observation is that a considerable fraction of the power radiated by a cellular telephone is absorbed in the proximal ear region, and there is no interest for safety certification and antenna design in retaining electromagnetic-field information in the weakly exposed regions. The authors have progressively reduced the finite difference time-domain space in the ear-to-ear, back-to-front, and bottom-to-top directions by embedding the weakly exposed sides of the head in the PML layers. Results show that, at the lower frequency of 835 MHz, only truncations in the ear-to-ear direction is appropriate for specific-absorption-rate (SAR) accuracy. However, at the personal communication system frequency of 1900 MHz, 1- and 10-g SARs within 1% of accuracy can be obtained by retaining just 4% of the original volume of the head model. This method indicates that high-resolution cellular telephone simulations can be performed with tremendous savings in execution times and memory requirements. All of the SAR results presented in this paper have been obtained with a laptop computer, and execution times as low as 1 min have been obtained for the fully optimized simulations at 1900 MHz. Furthermore, it is shown that by using a truncated half-model, it is possible to obtain accurate radiation patterns at both frequencies of 835 and 1900 MHz. Since both the SAR evaluation and radiation pattern calculation are needed for new antenna design, this should result in a highly efficient algorithm for electromagnetic design of new personal wireless devices.

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