Abstracts

Properties of guided modes on open structures near the cutoff region using a new version of complex effective dielectric constant

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Radiation region for open guiding structures is known to be further divided into antenna- and reactive-mode regions, and there is no clear cutoff point defined between the two regions. For a leaky-wave antenna, it is crucial that the antenna is designed to operate in the antenna-mode region so as to increase radiation efficiency, whereas in integrated circuits, the leakage should be suppressed to avoid unwanted coupling among circuits. Therefore, a reasonable definition of the two above-mentioned mode regions is necessary. In this paper, we propose a simple, but good alternative to define these two regions by means of a new version of complex effective dielectric constant, where the complex nature is due to leakage rather than dielectric or metal losses, as is customary. With the new approach, the reactive-mode region is found to be consistent with the conventional concept, and our results are similar to those in the literature. The present technique, however, helps in a better understanding of the results in a much easier way. Furthermore, we find for the first time that the attenuation constant in the deep reactive-mode region can be divided into two separate parts, one is due to the cutoff effect, while the other is caused by the leakage effect. Simple closed-form expressions are derived to determine the two kinds of effects. One can, therefore, gain some insight into the leakage effect in the reactive-mode region. A nonradiative-guide leaky-wave antenna is then investigated as a showcase and low radiation efficiency is observed in the reactive-mode region.

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