

Shape optimization of waveguide cut-off filter

Masayoshi SATAKE¹ and Hideyuki AZEGAMI¹

¹ Nagoya University, Japan

Abstract

In the present study, a numerical method to solve a non-parametric shape optimization problem of the electromagnetic field in frequency response problem with high frequency is developed. As an example of the problem, the design of waveguide cut-off filter is considered.

The design variable is chosen by the domain variation of the electromagnetic field from an initial domain. The main problem of the shape optimization problem is defined by the frequency response problem based on Maxwell's equations. The cost function is defined by a mean power loss with filtering weight on waveguide ports. Using the definitions, we formulate a non-parametric shape optimization problem, and theoretically derive the equations to evaluate the shape derivative of the cost function by the adjoint method. As an optimization scheme, the iterative method of reshaping by the H^1 gradient method is used. To solve the shape optimization problem of the waveguide cut-off filter, we developed a program using a commercial finite-element program to solve the boundary value problems of the main problem, the adjoint problem and the H^1 gradient method.

Numerical analysis is performed for a circular waveguide cut-off filter with different pipe diameters. The filtering weight is defined by a step function to a cut-off frequency wave. The performance of optimum shape obtained by the present method accords with that of the ideal shape empirically obtained.