Auto-optimization design of MILO

Sun Huifang Li Hanyu Dong Zhiwei Zhou Haijing

Institute of Applied Physics and Computational Mathematics, Beijing, 100094, china

***Abstract*—**A parallel 2-dimensional optimization PIC code syncretized the Genetic Algorithm is developed in order to improve the level of design of HPM (high power microwave) sources. This optimization code could be used to realize auto-optimization design of HPM sources. Both C-MILO and L-MILO are optimized using this code. By optimization, the efficiency of C-MILO rises to 15.4% from 10.8% and that of L-MILO rises to 17.7% from 12.6% while each input power is unchanged. The optimized results show that both the output power and efficiency of two MILOs are improved considerably with the input power unchanged.

I. INTRODUCTION

Recently, PIC (particle-In-Cell) codes are often used to optimized designs of HPM sources, that obviously shorten the period and cost. Howerver, using PIC codes to optimize a HPM source is very labor-intensive and slow, also due to the iterative nature of the optimization, the true optimal values are never found because the parameters are optimized one at a time instead of the simultaneous minimization process needed for multivariable systems[1].

Genetic Algorithm is an optimization algorithm which has been used widely[2]. In this paper, a parallel 2-dimensional optimization PIC code syncretized the Genetic Algorithm is developed and used to automatically optimize MILO(Magnetically Insulated Transmission Line Oscillator) which is one of the representative HPM (high power microwave) sources.

Master-slave parallel Genetic Algorithm is introduced in the parallel optimization code. The whole optimization code is composed of two parts named master code and slave code both independent from each other. The master code is Genetic Algorithm code which manages searched space of slave nodes and assigns seeds to generate initial population to slaves for their restarting of evolution process, while the slave code is 2D PIC code –KARAT[3] which implements numerical simulation tasks assigned by the master code and returns simulation results to the master code.

Two MILOs are optimized, one is our C-MILO[4] and the other is L-MILO produced by U.S.Air Force[5]. The optimization results are shown as follows.

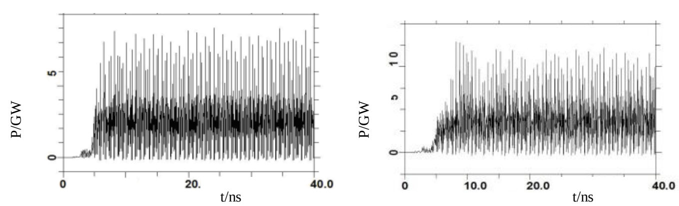
II. RESULTS

The output power of original MILO is shown in Figure 1.1. It obtains averaged output power of 2.55GW and efficiency of 10.8% at 3.7GHz when input voltage is 538kV and input power is 23.7GW with impedance of 12.21Ω.

The output power of optimized C-MILO is shown in Figure 1.2. It obtains averaged output power of 3.91GW and efficiency of 16.1% at 3.7GHz when input voltage is 550kV and input power is 24.3GW with impedance of 12.45Ω. In the optimized C-MILO, output power increases 50% compared to that of the original C-MILO under similar input conditions, while the frequency and impedance are almost unchanged.

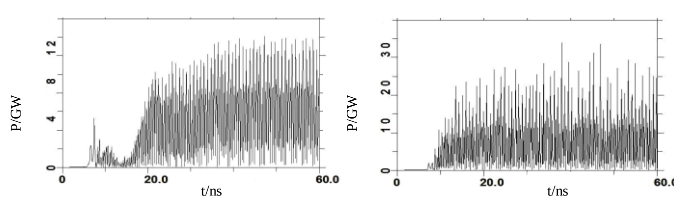
The output power of original L-MILO is shown in Figure 2.1. It obtains averaged output power of 6.19GW and efficiency of 12.63% at 1.2GHz when input voltage is 768kV and input power is 49.0GW with impedance of 12.04Ω.

The output power of optimized L-MILO is shown in Figure 2.2. It obtains averaged output power of 8.59GW and efficiency of 17.67% at 1.2GHz when input voltage is 775kV and input power is 48.6GW with impedance of 12.36Ω. In the optimized L-MILO, output power increases 38.8% compared to that of the original L-MILO under similar input conditions, while the frequency and impedance are almost unchanged and the rising time of microwave is obviously shorter.



1.1 The original C-MILO 1.2 The optimized C-MILO

Fig.1. The instantaneous output power spectrum of C-MILO



2.1 The original L-MILO 2.2 The optimized L-MILO

Fig.2. The instantaneous output power spectrum of L-MILO

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