Estimation of Machine Parameters in Superconducting Transformer using Differential Evolution

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When a transformer is energized in the power system, an exciting inrush current occurs, which affects the power quality, such as unnecessary operation of the protective relay and malfunction of the control device. In order to grasp and solve these problems, it is necessary to analyze the waveform at the time of occurrence of the inrush current under several conditions. It is believed that the same problem is applied to superconducting transformers. In previous researches, we used Genetic Algorithm (GA) to estimate the machine parameters of superconducting transformers from excited inrush current. In this study, the estimation technique was further developed using Differential Evolution (DE).

As a result of estimation by DE, the calculation time is reduced to 1/10, the evaluation value representing the difference between the estimated value and the measured value is reduced to about half, and the estimation accuracy is improved, compared to GA.

Fig. (1) shows the measured value and the estimated values of the waveform of the excitation inrush current. It can be seen that the estimation result of DE is closer to the measured value.

The influence of differences in parameters was investigated on the DE estimation results. Fig. (2) shows the changes in the evaluation values for various CR and F, where CR is the crossover ratio and F is the scaling factor, respectively. As the CR is larger, crossover takes place actively to search a wide range, so it is easier to find an optimal solution and the evaluation value becomes smaller. As the F is small, the search range is narrow and the evaluation value is large. On the other hand, if it is large, detailed search can not be performed near the optimum solution, and the evaluation value becomes large. As described above, it is important to set parameters such as the CR and the F appropriately for estimation using DE. In this estimation, the CR was 1.0 and the F was 0.6 for best results.
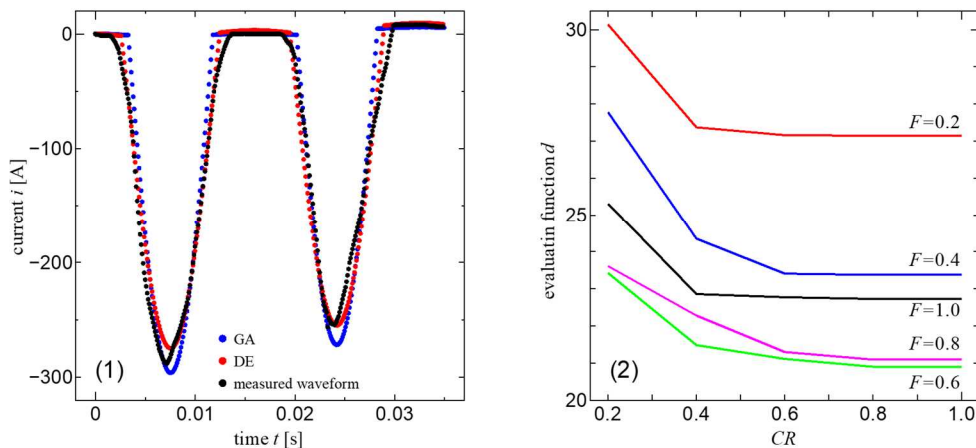
Fig. (1) Inrush current waveform calculated by GA and DE, (2) Values of the d at various CR and F

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