system on the basic shape of the design target element. However, the deformation patterns 310a, 310b do not have to indicate the displacement vector itself, as long as they indicate the displacement at each position in the relative coordinate system on the basic shape of the design target element. For example, they may include information that can specify the displacement vector (for example, displacement at each axis of the relative coordinate system).

[0040] In Fig. 3A and Fig. 3B, for convenience of notation, the displacement vectors are illustrated only at the positions of the grids indicated by dotted lines. However, such displacement vectors are set at all the coordinates of the deformation pattern application regions 320a, 320b. For example, by performing interpolation using the displacement vectors set at four vertices (for example, vertices 330a to 330d in Fig. 3A) of one grid indicated by dotted lines, the displacement vector of each coordinate in the region of the grid may be calculated. The interpolation is performed, for example, by calculating a weighted average value of the displacement vectors set at the four vertices. For example, as the displacement vector of a certain coordinate within a certain grid, the weighted average value of the displacement vectors at the four vertices of the grid is calculated. Weights (namely, weights for the displacement vectors at the four vertices of the grid) used in calculating the weighted average value are set

is omitted here.

[0062] <<Design target element change part 133>>

The design target element change part 133 changes the shape of the design target element using the deformation patterns 310a, 310b and the application parameter. In this embodiment, the design target element change part 133 applies the nonlinear mapping to the design target element by applying the deformation patterns 310a, 310b to the design target element according to the application method of the deformation patterns 310a, 310b included in the application parameter acquired by the parameter acquisition part 132.

[0063] As described previously, in this embodiment, there is explained, as an example, the case where the application method of the deformation patterns 310a, 310b and the linear mapping parameter are included in the application parameter (optimization parameter). Therefore, in this embodiment, the design target element change part 133 performs application of the deformation patterns 310a, 310b to the design target element according to the application method of the deformation patterns 310a, 310b to change the shape of the design target element, and application of the linear mapping to the design target element. Here, when the linear mapping is applied to the design target element and then the shape of the design target element is changed with the content indicated in the deformation patterns 310a, 310b, the design target

change part 133 applies linear mapping to the design target elements 240c, 240d after deformed due to the deformation patterns 310a, 310b based on the linear mapping parameter out of the application parameter included in the candidate solution of the optimization parameter set for the design target element, to thereby calculate the design target elements 250a, 250b after linear mapping (see Fig. 5C).

[0118] Then, at Step S808, the design target element change part 133 determines whether or not there is a design target element where overlap•protrusion has occurred at the design target elements 250a, 250b after linear mapping. As a result of this determination, when there are no design target element 250a or 250b after linear mapping where overlap•protrusion has occurred (NO at Step S808), the processing at Step S809 is omitted, and processing at Step S810 in Fig. 8B, which will be described later, is performed. On the other hand, when there is at least one design target element 250a or 250b after linear mapping where overlap•protrusion has occurred (YES at Step S808), the processing at Step S809 is performed.

[0119] At Step S809, the design target element change part 133 changes the design target elements 250a, 250b after linear mapping again so that the overlap•overflow at the design target elements 250a, 250b after linear mapping that have overlapped•protruded are eliminated (see Fig. 6A to Fig. 6D and Fig. 7).

[0120] Then, at Step S810, the characteristic value

been subjected to the image processing is output on the display 909, for example.

The user interface 908 is a part in which an operator OP gives an instruction to the core design apparatus 100. The user interface 908 includes buttons, switches, dials, and so on, for example. Further, the user interface 908 may include a graphical user interface using the display 909.

[0132] The display 909 displays an image based on a signal output from the image processing circuit 906. The I/F circuit 907 exchanges data with a device connected to the I/F circuit 907. In Fig. 9, as the device to be connected to the I/F circuit 907, the user interface 908 and the display 909 are illustrated. However, the device to be connected to the I/F circuit 907 is not limited to these. For example, a portable storage medium may be connected to the I/F circuit 907. Further, at least a part of the user interface 908 and the display 909 may be provided outside the core design apparatus 100.

[0133] Incidentally, the CPU 901, the main memory 902, the auxiliary memory 903, the signal processing circuit 905, the image processing circuit 906, and the I/F circuit 907 are connected to the bus 910. Communication among these components is performed via the bus 910. Further, the hardware of the core design apparatus 100 is not limited to the hardware illustrated in Fig. 9 as long as it can perform the previously-described functions of the core design

apparatus 100. For example, a GPU may be used as a processor instead of or in addition to the CPU 901.

[0134] [Calculation example]

Next, there are explained calculation examples. Fig. 10A to Fig. 10C are views illustrating a core before design and a core after design.

Fig. 10A illustrates an original shape of the core. In this calculation example, the addition of a flux barrier to the core illustrated in Fig. 10A was performed using the method described in Patent Literature 1 and the method explained in this embodiment.

[0135] As described above, a calculation target element in this calculation example is the flux barrier. In Fig. 10A to Fig. 10C, the region of the flux barrier is a white region that is not circular. The region of the iron core and the region of the permanent magnet are gray regions that are different from each other in concentration (the region of the permanent magnet is rectangular). Incidentally, six circular white regions illustrated in Fig. 10A to Fig. 10C are predetermined elements of the core other than the design target element (elements whose shape is not changed).

[0136] In this calculation example, the region surrounded by the outer edge of the region of the iron core in Fig. 10A (an annular sector-shaped region with a central angle of 180° in Fig. 10A) was set as a