SUMMARY

[0010] Embodiments provided herein are directed to systems and methods that facilitate the reduction in amplitude of undesirable eddy currents (wall currents), e.g., translation-induced eddy currents such as eddy currents induce by translation of FRC plasmas, while leaving beneficial eddy currents unaffected. The reduction in amplitude of undesirable eddy currents is achieved by inducing opposing currents in the same structures prior to plasma translation, for example using active coils. If both tangential and normal components of the total magnetic field on a surface separating the plasma from the conducting structures are measured, the field can be decomposed into components produced by the plasma and components produced by exterior currents (eg. equilibrium coil currents). By subtracting the known fields from exterior coils, the field due to eddy current remains. The corresponding eddy current distribution can be reconstructed from the time evolution of this field. With the eddy current distribution known, active coils are used to induce a similar distribution with an opposite sign before the plasma translates into the chamber. Calculating the necessary coil currents requires knowledge of only the geometry of the active coils and passive structures. When the plasma translates into the confinement chamber, the two eddy current distributions superimpose and cancel. The more exact the eddy current distribution is reproduced, the more complete is the cancellation.

[0010a] According to a first aspect of the present disclosure, there is provided a method for reducing undesired eddy currents induced in a conducting structure, the method comprising the steps of inducing a first set of eddy currents in a conducting prior to inducing a second set of eddy currents in the conducting structure, wherein the first set of eddy currents having a distribution substantial equal to and opposite in sign to the distribution of the second set of eddy currents to substantial cancel the second set of eddy currents upon inducement of the second set of eddy currents in the conducting structure.

[0010b] According to a second aspect of the present disclosure, there is provided a system for reducing undesired eddy currents induced in a vessel wall, the system comprising a vessel having a wall and an interior, a plurality coils positioned around the vessel, and a control system coupled to the plurality of coils and configured to induce a first set of eddy currents in the wall of the vessel prior to a second set of eddy currents being induced in the wall of the vessel, wherein the first set of eddy currents having a distribution substantial equal to and

opposite in sign to the distribution of the second set of eddy currents to substantial cancel the second set of eddy currents upon inducement of the second set of eddy currents in the wall of the chamber.

[0010c] According to a third aspect of the present disclosure, there is provided a method for reducing undesired eddy currents induced in a conducting structure, the method comprising the steps of inducing a first set of eddy currents in a wall of a vessel having a wall and an interior prior to inducing a second set of eddy currents in the wall of the vessel, wherein the first set of eddy currents having a distribution substantial equal to and opposite in sign to the distribution of the second set of eddy currents to substantial cancel the second set of eddy currents upon inducement of the second set of eddy currents in the conducting structure.

[0011] Various embodiments described herein aim to advantageously:

- reduce time-varying external fields due to decaying eddy currents, which interfere with plasma control;
- reduce symmetry-breaking effects of a non-axisymmetric wall; since both pre-induced and translation-induced eddy currents have the same 3-D structure, 3-D fields are reduced without the need for non-axisymmetric coils; and
- enable the installation of close fitting, axisymmetric, in-vessel structures to increase passive stabilization of axisymmetric and non-axisymmetric instabilities.

[0012] Other systems, methods, features and advantages of the example embodiments will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description.