

CLAIMS

What is claimed is:

1. A surgical system comprising:
 - an internal anchor assembly, the internal anchor assembly configurable to be inserted into and positioned inside a cavity of a body; and
 - an external anchor assembly configurable to magnetically couple to the internal anchor assembly, the external anchor assembly including:
 - a magnetic assembly having one or more superconducting magnets configurable to generate a magnetic field and a conductive housing for receiving the one or more superconducting magnets;
 - a temperature control section configurable to control a temperature of the one or more superconducting magnets via the conductive housing; and
 - an external anchor body configurable to receive the magnetic assembly and the temperature control section, the external anchor body fixably positionable outside of the body.
2. The surgical system of claim 1, wherein the magnetic assembly is configurable to generate the magnetic field with a magnitude of about 0 to 5 Tesla.
3. The surgical system of claim 1, wherein the external anchor assembly is configurable to selectively vary the magnetic field applied at the internal anchor assembly between a magnitude of about 0 to 2 Tesla.
4. The surgical system of claim 3, wherein, when the external anchor assembly magnetically couples to the internal anchor assembly, and when the magnetic assembly is magnetically coupled to the internal anchor assembly at a first separation distance from the

internal anchor assembly, the external anchor assembly is configurable to vary the magnitude of the magnetic field applied to the internal anchor assembly by varying the first separation distance.

5. The surgical system of claim 4, wherein

the external anchor assembly further comprises a support structure, the support structure selectively configurable to fixably position the external anchor body outside of the body,

the magnetic field applied at the internal anchor assembly is reduced by selectively configuring the support structure to increase the first separation distance, and

the magnetic field applied at the internal anchor assembly is increased by selectively configuring the support structure to decrease the first separation distance.

6. The surgical system of claim 4, further comprising an intermediary member positionable between the external anchor assembly and the internal anchor assembly,

wherein the first separation distance is varied by selectively varying a dimension of the intermediary member.

7. The surgical system of claim 6, wherein the intermediary member is an inflatable bladder.

8. The surgical system of claim 1, wherein the external anchor assembly is configurable to selectively vary the generated magnetic field between a magnitude of about 0 to 5 Tesla.

9. The surgical system of claim 8, wherein the external anchor assembly is configurable to selectively vary the generated magnetic field by varying a temperature of the one or more superconducting magnets.

10. The surgical system of claim 9, wherein the external anchor assembly is configurable to selectively diminish the generated magnetic field by increasing the temperature of the one or more superconducting magnets to be equal to or greater than a critical temperature of between about 90 to 100 K.
11. The surgical system of claim 1, wherein the magnetic assembly comprises a plurality of superconducting magnets configured in one or more vertically stacked arrangements.
12. The surgical system of claim 11, wherein
 - each of the superconducting magnets comprise a circular cross-sectional shape with a radius,
 - each of the one or more vertically stacked arrangements of superconducting magnets has a collective height, and
 - the collective height is equal to or greater than the radius.
13. The surgical system of claim 11, wherein
 - each of the superconducting magnets comprise a hexagonal cross-sectional shape with a first distance between opposing corners,
 - each of the one or more vertically stacked arrangements of superconducting magnets has a collective height, and
 - the collective height is equal to or greater than the first distance between opposing corners.
14. The surgical system of claim 1, wherein the one or more superconducting magnets comprise Ba, Cu, and O.
15. The surgical system of claim 1, wherein:

the temperature control section comprises a heat rod and a cryo-cooler,
the heat rod is in contact with the conductive housing and the cryo-cooler,
the cryo-cooler is configurable to control the temperature of the superconducting magnets via the heat rod and the conductive housing,

the external anchor body includes an elongated body comprising a first end and a second end opposite the first end,

the elongated body of the external anchor body is configurable to receive the magnetic assembly at the first end,

the elongated body of the external anchor body is configurable to receive the cryo-cooler at the second end, and

the elongated body of the external anchor body is configurable to receive the heat rod at least between the first end and the second end.

16. The surgical system of claim 1, further comprising an instrument assembly having an instrument at a first end and an instrument assembly attaching section at a second end,

wherein the internal anchor assembly further comprises an internal anchor attaching section, and

wherein the instrument assembly is configurable to secure to the internal anchor assembly by securing the instrument assembly attaching section to the internal anchor attaching section.

17. The surgical system of claim 16, wherein, when the external anchor assembly is magnetically coupled to the internal anchor assembly via the applied magnetic field and the instrument assembly is secured to the internal anchor assembly, the instrument of the instrument assembly is operable to provide an applied force of between about 0 to 5 N.

18. The surgical system of claim 1, further comprising a controller, the controller configurable to:

configure a magnitude of the magnetic field applied, by the magnetic assembly, at the internal anchor assembly; and

configure the temperature control section to control the temperature of the one or more superconducting magnets.

19. An external anchor assembly for use with a surgical system, the surgical system having an internal anchor assembly configurable to be inserted into and positioned inside a cavity of a body, the external anchor assembly comprising:

a magnetic assembly having one or more superconducting magnets configurable to generate a magnetic field and a conductive housing for receiving the one or more superconducting magnets;

a temperature control section configurable to control a temperature of the one or more superconducting magnets via the conductive housing; and

an external anchor body configurable to receive the magnetic assembly and the temperature control section, the external anchor body fixably positionable outside of the body;

wherein the magnetic assembly is configurable to magnetically couple to the internal anchor assembly via the magnetic field.

20. The external anchor assembly of claim 19, wherein the magnetic assembly is configurable to generate the magnetic field with a magnitude of about 0 to 5 Tesla.

21. The external anchor assembly of claim 19, wherein the external anchor assembly is configurable to selectively vary the magnetic field applied at the internal anchor assembly between a magnitude of about 0 to 2 Tesla.

22. The external anchor assembly of claim 21, wherein, when the external anchor assembly magnetically couples to the internal anchor assembly, and when the magnetic assembly is magnetically coupled to the internal anchor assembly at a first separation distance from the internal anchor assembly, the external anchor assembly is configurable to vary the magnitude of the magnetic field applied at the internal anchor assembly by varying the first separation distance.

23. The external anchor assembly of claim 21, wherein
the external anchor assembly further comprises a support structure, the support structure selectively configurable to fixably position the external anchor body outside of the body,

the magnetic field applied at the internal anchor assembly is reduced by selectively configuring the support structure to increase the first separation distance, and

the magnetic field applied at the internal anchor assembly is increased by selectively configuring the support structure to decrease the first separation distance.

24. The external anchor assembly of claim 21, further comprising an intermediary member positionable between the external anchor body and the internal anchor assembly,

wherein the first separation distance is varied by selectively varying a dimension of the intermediary member.

25. The external anchor assembly of claim 24, wherein the intermediary member is an inflatable bladder.

26. The external anchor assembly of claim 19, wherein the external anchor assembly is configurable to selectively vary the generated magnetic field between a magnitude of about 0 to 5 Tesla.
27. The external anchor assembly of claim 26, wherein the external anchor assembly is configurable to selectively vary the generated magnetic field by varying a temperature of the one or more superconducting magnets.
28. The external anchor assembly of claim 27, wherein the external anchor assembly is configurable to selectively diminish the generated magnetic field by increasing the temperature of the one or more superconducting magnets to be equal to or greater than a critical temperature of between about 90 to 100 K.
29. The external anchor assembly of claim 19, wherein the magnetic assembly comprises a plurality of superconducting magnets configured in one or more vertically stacked arrangements.
30. The external anchor assembly of claim 29, wherein
each of the superconducting magnets comprise a circular cross-sectional shape with a radius,
each of the one or more vertically stacked arrangements of superconducting magnets has a collective height, and
the collective height is equal to or greater than the radius.
31. The external anchor assembly of claim 29, wherein
each of the superconducting magnets comprise a hexagonal cross-sectional shape with a first distance between opposing corners,

each of the one or more vertically stacked arrangements of superconducting magnets has a collective height, and

the collective height is equal to or greater than the first distance between opposing corners.

32. The external anchor assembly of claim 19, wherein the one or more superconducting magnets comprise Ba, Cu, and O.

33. The external anchor assembly of claim 19, wherein

the temperature control section comprises a heat rod and a cryo-cooler,

the heat rod is in contact with the conductive housing and the cryo-cooler,

the cryo-cooler is configurable to control the temperature of the superconducting magnets via the heat rod and the conductive housing,

the external anchor body includes an elongated body comprising a first end and a second end opposite the first end,

the elongated body of the external anchor body is configurable to receive the magnetic assembly at the first end,

the elongated body of the external anchor body is configurable to receive the cryo-cooler at the second end, and

the elongated body of the external anchor body is configurable to receive the heat rod at least between the first end and the second end.

34. The external anchor assembly of claim 19, further comprising an instrument assembly having an instrument at a first end and an instrument assembly attaching section at a second end,

wherein the internal anchor assembly further comprises an internal anchor attaching section, and

wherein the instrument assembly is configurable to secure to the internal anchor assembly by securing the instrument assembly attaching section to the internal anchor attaching section.

35. The external anchor assembly of claim 33, wherein, when the external anchor assembly is magnetically coupled to the internal anchor assembly via the applied magnetic field and the instrument assembly is secured to the internal anchor assembly, the instrument of the instrument assembly is operable to provide an applied force of between about 0 to 5 N.

36. The external anchor assembly of claim 19, further comprising a controller, the controller configurable to:

configure a magnitude of the magnetic field applied, by the magnetic assembly, at the internal anchor assembly; and

configure the temperature control section to control the temperature of the one or more superconducting magnets.