one central means for ease of use. Surprisingly, the linkage to the central operational resources is operationally maintained during translational movement of the biological units along the vertical curved path of the carousel and during any individual adjustment of axial rotation of any one of the units. This is particularly advantageous for being able to provide multiple biological production units on a single carousel each with customized cell and/or tissue culture/engineering processes, yet optionally all share the same central operational resources and also share the same translational movement ability for user positioning and separate ability for independent axial rotation.

The automated carousel of the disclosure is advantageously configured to utilize vertical space for the distribution, operation and uniform translational movement of multiple biological production units arranged in a close spatial relationship along its curved vertical path. Translational movement is in a vertical plane and follows the curved shape of the carousel. Translational movement may be up to about 180 degrees clockwise or counterclockwise, of varying speeds and is user controlled. The translational movement is designed to be precise and in controlled increments such that an operator (no matter what height) can position any one of the biological units to a position for ergonomic access whether in a standing or a sitting position. The carousel is configured with a safety stop mechanism to stop movement at any time as desired or required. The axial rotation of any one individual biological production unit may also be clockwise or counterclockwise to provide a rocking motion or for agitation.

Attachment of the biological production units to the carousel is reversible such that each unit can be inspected, removed, replaced or repositioned to a different position on the carousel or to a different carousel. In an example, the biological production units are attached in a cantilevered orientation to allow easier access by a user and to maintain the efficient use of floor space.

It is contemplated that different types of biological production units may be mounted to one carousel so long as the basic size, weight and independent functioning capabilities are comparable to other units mounted on the carousel in order not to negatively affect the overall balance of the carousel, the uniform bi-directional translational movement along the carousel frame, the gravitational orientation of the biological production units mounted thereon, or the ability to independently dynamically adjust the bi-directional axial orientation relative to gravity of any one of the units. Further, each of the biological production units mounted on the carousel

may support a different cell culture and/or tissue culture system therein customized for a specific need or a specific patient.

The automated carousel may be provided as a system disposed vertically within a vertical housing for central operation and central provision of operational resources to each of the independently controlled biological production units that function to support a cell and/or tissue culture system therein. The vertical housing serves as a support frame and attachment structure for the carousel to maintain an upright positioning of the carousel and for its operation. The vertical housing is configured to readily permit reversible attachment of the biological production units, their proper translational movement along the carousel shape, and for user access. The vertical housing has a supporting base and retractable wheels for ease of relocation. The vertical housing is configured for ease of assembly and disassembly, for centrally storing required resources and for user safety.

User access, service access and space efficiency is improved when supporting multiple biological production units on an automated carousel of the disclosure. Furthermore, the carousel of the disclosure can provide increased expandability, by taking full advantage of the height of a biological production facility. Several carousels can be arranged and used in series. Therefore numerous biological production units can be run in a production facility in a space efficient yet operator accessible manner.

The carousel is used in conjunction with one or more controllers, controller communications interface, associated software and remote management device (e.g. computer). Software is customizable for specific applications, is menu-driven and user-friendly. For example, rotation of the biological production units attached to the carousel may be defined by user set programs for precise control of movement and positioning of each biological production unit. The carousel can be operable from a central workstation or remote management device. A convenient user actuated touch pad screen device may be used and connected to each of the biological production units operationally connected to a central computer.

According to an example of the disclosure, is an upright carousel for translating a plurality of biological units in unison along a vertical elliptical orbit while maintaining each individual biological load stable relative to gravity, and providing for individual dynamic axial rotation of any one or all of the biological units.

In examples, the carousel comprises a spacing adjustment means to adjust the spacing of each biological unit relative to adjacent biological units so as to maximize the spatial density of biological units in selected zones of the carousel by close spacing and enhance user access to biological units in other selected zones by open spacing.

In examples, each of the biological units are independently operable and linked to a central source of operational resources.

In examples, the biological loads are sensitive to orientation relative to gravity.

In examples, the carousel comprises an upright drive track and a support track vertically offset from one another and held together by a plurality of linkage mechanisms, each of the linkage mechanisms adapted to support a biological unit during translational movement along the elliptical orbit of the drive track and support track.

In examples, the biological units are supported in a cantilevered position for ease of user access once positioned.

In examples, the plurality of cantilevered biological units are translationally positioned in unison along an upright frame comprising two vertically offset tracks. In examples, the tracks are substantially oval. In examples oval closed loops.

In examples, the speed and direction of translation (clockwise or counter-clockwise) is user controlled and adjustable.

In examples, alignment of each cantilevered biological unit is substantially maintained relative to gravity during translational movement of the units or when the carousel is stationary.

In examples, the carousel provides dynamic adjustment of axial orientation (bi-directional) relative to gravity of each independent cantilevered biological unit during translational movement of the units or when stationary.

In examples, precise positioning of each cantilevered biological unit is user controlled for ergonomic access.

In examples, the cantilevered biological unit is a cantilevered biological production unit.

In examples, the cantilevered biological production unit operationally supports an automated cell culture and/or tissue engineering system.

In examples, each of the biological production units are independently operable to provide a customized cell culture and/or tissue engineering systems. In examples, the cell culture and/or tissue engineering systems are for autologous cell therapies.

In examples, the carousel reduces overall space/storage footprints while increasing employee safety and efficiency.

In examples, the carousel is part of a system that further comprises a housing for vertical operational support of the carousel and means for connection of each biological production unit in succession to a central source of auxiliaries and resources.

In examples of the disclosure is an automated carousel system for organizing, storing, and ergonomically accessing cell and/or tissue engineering systems enclosed in a biological production unit.

In examples, the automated carousel and systems incorporating the carousel greatly increases facility biological operational capacity by fully utilizing overhead space to recover up to 70% of the floor space required by conventional biological culturing systems.

According to an example of the disclosure is an automated vertical track assembly for supporting a plurality of biological units, wherein the carousel is configured for:

(i) user operated start and stop of translational movement of the biological units in unison along a defined path of the vertical track while maintaining each of the biological units properly oriented with respect to gravity; and

(ii) user operated start and stop of axial rotation of individual biological units;

wherein during both (i) and (iii) each of the biological units is independently operable support a customized automated cell and tissue culture system therein; and

wherein each of said biological units is interlinked to share a central source of operational resources.

According to an example of the disclosure is a vertical carousel comprising a plurality of biological units substantially geometrically constrained to translationally move in unison in a vertical elliptical orbit while maintaining the proper orientation of each of the plurality of biological units with respect to gravity, and separately axially rotating any independent one or more of the plurality of biological units.

According to another example of the disclosure is a vertical carousel comprising:

- a plurality of biological units substantially geometrically constrained for translational movement along a vertical elliptical orbit in unison while maintaining a stable orientation of each of the plurality of biological units with respect to gravity, and for separate axial rotation of any one or more of the plurality of biological units;

- means to control the translational movement of the biological units for user positioning; and

- means to actuate the axial rotation of the any one or more of the plurality of biological units.

According to an example of the disclosure is an automated carousel comprising:

- a vertical track assembly comprising a drive track and a support track vertically offset from one another;

- a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each translation assembly supporting a cantilevered biological unit, wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological unit with respect to gravity, and separately, (ii) axial rotation of each biological unit.

According to an example of the disclosure is a system for maximizing cell and/or tissue engineering production, the system comprising a plurality of automated carousels as described herein supported and arranged in series.

According to a further example of the disclosure is a method for maximizing cell and/or tissue engineering production, the method comprising providing a series of the automated carousel system as described herein in a production facility.

According to a further example of the disclosure is a translation assembly for a vertical carousel having a drive track and vertically off set support track, for supporting a biological unit for translational movement and independent axial rotation, the translation assembly comprising:

a first end defining a reversible coupling for receiving an input shaft of a biological unit;

a central hub comprising:

an outer hub shell supporting a drive carriage cooperatively engaged with the drive track for translational movement thereon, and

an inner hub comprising a separate mechanism configured for the axial rotation of the biological unit; and

a second end having a vertically downward extending resistance arm mounted via the inner hub and at its vertically lowest point a pivotally connected support carriage cooperatively engaged with the support track for translational movement thereon, wherein the vertically

extending resistance arm prevents rotation of the inner hub and is maintained in a vertical orientation by geometrical constraint arising from the fixed vertical offset of the drive track and support track during translational movement along the tracks.

According to an example of the disclosure is an automated carousel system for the distribution and ergonomic positioning of multiple biological production units each of the units comprising an automated individually operable cell and/or tissue culture system, the automated carousel system comprising:

an automated carousel comprising:

- a vertical track assembly comprising a drive track and a support track vertically offset therefrom;

- a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered biological production unit, wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological production unit with respect to gravity, and separately, (ii) axial rotation of each biological production unit;

- means for independent biological control of each cell and/or tissue culture system within each of said biological production units;

- a vertical housing assembly supporting the carousel, the housing assembly comprising a central source of operational resources;

- means for interconnecting the central source of operational resources to each successive biological production unit; and

computer connection.

According to an example of the disclosure is a method for improving ergonomics for users of an automated carousel system that comprises a plurality of independent culture systems each supported within a biological production unit, the method comprising:

mounting a plurality of biological production units on an automated carousel comprising:

- a vertical track assembly comprising a drive track and a support track vertically offset therefrom;

- a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered

biological production unit, wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological production unit with respect to gravity, and separately, (ii) axial rotation of each biological production unit;

wherein (i) and (ii) is user controlled for ergonomic access to each biological production unit by a user.

According to a further example of the disclosure is a method for increasing biological production capacity utilizing cell and/or tissue culture systems in a production facility, the method comprising:

supporting a plurality of biological production units each housing a cell and/or tissue culture system on an upright automated carousel, the carousel comprising a plurality of translation assemblies connecting a drive track and a support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered biological production unit, wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological production unit with respect to gravity, and separately, (ii) axial rotation of each biological production unit.

According to a further example of the disclosure is an ergonomic automated carousel for supporting automated individually operable biological systems, the carousel comprising:

a plurality of translation assemblies connecting a drive track and a support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered biological production unit, wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological production unit with respect to gravity, and separately, (ii) axial rotation of each biological production unit; and

means to select translationally move any one of the biological production units along the connected track to a specific position to accommodate a user for ergonomic inspection by said user.

According to a further example of the disclosure is a method for ergonomically positioning an automated selected cell culture and/or tissue engineering system for inspection by a user, the method comprising:

In any of the aforementioned examples, one of skill in the art recognizes that the automated upright carousel can operationally support any desired number of biological production units such as at least two biological production units, up to about six units, up to about eight units, up to about 10 units, up to about 12 units, up to about 14 units, up to about 16 units, up to about 18 units or up to about 20 units or more.

The automated carousel enables ergonomic access to a specific independent cell and/or tissue culture system without disturbance of the biological processes underway in any of the other independent multiple cell and/or tissue culture systems. The carousel is generally height adjustable and easily configurable to a wide variety of user sizes, shapes and weights. The ergonomic carousel is configured to alleviate existing muscular, skeletal or nervous system issues and/or configured to prevent such issues in the first instance for laboratory personnel. In examples, the ergonomic carousel is suitable for vertical adjustment for a sitting configuration to a standing configuration or vice-versa.

In one aspect, the present disclosure refers to an automated carousel comprising: a substantially vertical track assembly comprising a drive track and a support track vertically offset and spaced apart from one another; a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each translation assembly supporting a cantilevered biological unit, said plurality of translation assemblies configured to provide: (i) translational movement of each biological unit along the drive track and the support track in unison or separately, while maintaining an orientation of each cantilevered biological unit stable with respect to gravity, and separately, (ii) axial rotation of each biological unit.

In one aspect, the present disclosure refers to an automated carousel system for the distribution and ergonomic positioning of multiple biological production units, each of the biological production units comprising an automated individually operable cell and/or tissue engineering system, the automated carousel system comprising: an automated carousel comprising: a substantially vertical track assembly comprising a drive track and a support track vertically offset and spaced apart from one another; and a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered biological production unit, wherein said plurality of translation assemblies are configured to provide (i) translational movement of each biological production unit along the connected drive track and support track in unison or

separately while maintaining an orientation of each cantilevered biological production unit stable with respect to gravity, and separately, (ii) axial rotation of each biological production unit; a controller for independent biological control of each cell and/or tissue culture system within each of said biological production units; a vertical housing assembly supporting the automated carousel, the housing assembly comprising a central source of operational resources; and a connector for interconnecting the central source of operational resources to each successive biological production unit; and a computer connection.

In one aspect, the present disclosure refers to a method for improving ergonomics for users of an automated carousel system that comprises a plurality of independent cell and/or tissue engineering systems each supported within a biological production unit, the method comprising: mounting a plurality of biological production units on an automated carousel comprising: a vertical track assembly comprising a drive track and a support track vertically offset and spaced apart from one another; a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered biological production unit, wherein said plurality of translation assemblies are configured to provide (i) translational movement of each biological production unit along the connected drive track and support track in unison or separately while maintaining an orientation of each cantilevered biological production unit stable with respect to gravity, and separately, (ii) axial rotation of each biological production unit; wherein (i) and (ii) are user controlled for ergonomic access to each biological production unit by a user.

A1. An automated vertical track assembly for supporting a plurality of biological units, wherein the vertical track assembly is configured for:

(i) user operated start and stop of translational movement of the biological units in unison along a defined path of the vertical track assembly while maintaining each of the biological units properly oriented with respect to gravity; and

(ii) user operated start and stop of axial rotation of individual biological units;

wherein during both (i) and (iii) each of the biological units is independently operable to support a customized automated cell and tissue culture system therein; and

wherein each of said biological units is interlinked to share a central source of operational resources.

A2. A vertical carousel comprising a plurality of biological units substantially geometrically constrained to translationally move in unison in a predefined orbit while maintaining the proper orientation of each of the plurality of biological units with respect to gravity, and separately axially rotating any independent one or more of the plurality of biological units.

A3. A vertical carousel comprising a plurality of biological units substantially geometrically constrained to translationally move in unison in a predefined orbit while maintaining the proper orientation of each of the plurality of biological units with respect to gravity, and separately the ability to adjust the spacing of each biological unit relative to adjacent biological units so as to

maximize the spatial density of biological units in selected zones of the carousel by close spacing and enhance user access to biological units in other selected zones by open spacing.

A4. A vertical carousel comprising:

- a plurality of biological units substantially geometrically constrained for translational movement along a vertical elliptical orbit in unison while maintaining a stable orientation of each of the plurality of biological units with respect to gravity, and for separate axial rotation of any one or more of the plurality of biological units;

- means to control the translational movement of the biological units for user positioning; and

- means to actuate the axial rotation of the any one or more of the plurality of biological units during translational movement or when stationary.

1. An automated carousel comprising:

- a vertical track assembly comprising a drive track and a support track vertically offset from one another;

- a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each translation assembly supporting a cantilevered biological unit,

wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological unit with respect to gravity, and separately, (ii) axial rotation of each biological unit.

1a. The automated carousel of item 1a, wherein each of the plurality of translation assemblies is a horizontal hub assembly.

1b. The automated carousel of item 1a, wherein said horizontal hub assembly comprises:

a first end defining a reversible coupling for receiving an input shaft of the cantilevered biological unit;

a central hub comprising:

an outer hub shell supporting a drive carriage cooperatively engaged with the drive track for translational movement thereon, and

an inner hub comprising a separate mechanism configured for the axial rotation of the biological unit; and

a second end having a vertically downward extending resistance arm mounted via the inner hub and at its vertically lowest point a pivotally connected support carriage cooperatively engaged with the support track for translational movement thereon, wherein the vertically extending resistance arm prevents rotation of the inner hub and is maintained in a vertical orientation by geometrical constraint arising from the fixed vertical offset of the drive track and support track during translational movement along the tracks.

2. The automated carousel of item 1b, wherein the reversible coupling is a cantilevered coupling that extends laterally.

2a. The automated carousel of item 1b, 2 or 2a, wherein during translational movement at track bends, the outer hub shell and affixed drive carriage undergo rotation and inversion while simultaneously the corresponding support carriage pivots from a vertical to a horizontal position, both drive carriage and support carriage remaining cooperatively engaged with their respective tracks and wherein the resistance arm remains vertically downwardly orientated.

3. The automated carousel of any one of items 1b, 2 or 2a, wherein the separate mechanism in the inner hub comprises a motor driven central shaft for engaging with the input shaft of the biological unit, wherein actuation of the motor actively rotates the central shaft at a controlled speed causing axial rotation of the associated biological unit.

3a. The automated carousel of item 3, wherein said axial rotation is intermittent or continuous.

3b. The automated carousel of item 3, wherein said axial rotation is bi-directional.

4. The automated carousel of any one of items 1b, 2, 2a or 3, wherein said drive carriage comprises a drive block assembly with one face thereof comprising affixed vertically arranged pairs of outwardly projecting bearing members for gripping the drive track and for engaging with a drive means adapted to move along the course of travel defined by the drive track.

5. The automated carousel of any one of items 1b, 2, 2a, 3 or 4, wherein said support carriage comprises a support block assembly with one face thereof comprising affixed vertically arranged pairs of outwardly projecting bearing members for gripping the support track and for engaging with a drive means adapted to move along the course of travel defined by the track.

5a. The automated carousel of item 4 or 5, wherein the translational movement of the support carriage is synchronous with the translational movement of the drive carriage.

6. The automated carousel of any one of items 1b, 2, 2a, 3, 4 or 5, further wherein said second end of the horizontal hub assembly comprises a port for entry of a connection means for centrally provided operational resources to the biological unit.

7. The automated carousel of any one of items 1b, 2, 2a, 3, 4, 5 or 6, wherein said port leads to a hollow shaft extending through the central hub to the biological unit.

8. The automated carousel of item 7, wherein the connection means comprises cabling enclosing separate resources, the cabling originating from a central source and connecting each successive biological unit on said carousel.

9. The automated carousel of item 8, wherein the operational resources are electrical supply lines, gas supply lines and controller connections.

10. The automated carousel of any one of items 1 to 9, wherein the translational movement along the connected tracks is clockwise or counterclockwise.

11. The automated carousel of item 10, wherein the translational movement along the connected tracks is about 180 degrees.

12. The automated carousel of item 11, wherein speed of the translational movement is adjustable.

13. The automated carousel of item 12, further operatively connected to a means for interrupting and/or stopping translational movement.

14. The automated carousel of any one of items 1 to 13, wherein said cantilevered biological unit is a biological production unit.

15. The automated carousel of item 14, wherein said biological production unit supports an individually operationally controlled cell and/or tissue engineering system.

16. The automated carousel of item 15, wherein said cell and/or tissue engineering system performs one or more of: sterile reception/storage of tissue biopsy; automated monitoring of digestion process; digestion of biopsy tissue to yield disassociated cells;
cell sorting and selection, safe waste collection; cell seeding on or within a proliferation substrate; ;scaffold proliferation of cells to expand cell populations; cell washing and cell collection; cell seeding on or within a tissue engineering scaffold or matrix; cell differentiation to allow specialization of cellular activity; tissue formation; mechanical and/or biochemical stimulation to promote tissue maturity; harvest of tissue engineered constructs/implants for reconstructive surgery; and storage and transportation of cells and implantable tissue.

17. The automated carousel of any one of items 1 to 16, wherein said drive track and said support track are substantially oval, circular or elliptical.

18. The automated carousel of item 17, wherein said drive track and said support track are oval.

19. The automated carousel of any one of items 1 to 18, wherein comprising up to 24 translation assemblies each supporting a cantilevered biological unit.

19a. The automated carousel of any one of items 1 to 19, further comprising means to adjust spacing of each biological unit relative to adjacent biological units so as to maximize the spatial density of biological units in selected zones of the carousel by close spacing and enhance user access to biological units in other selected zones by open spacing.

19b. The automated carousel of any one of item 1 to 19a, wherein the adjustment of spacing can be during translational movement of the biological units or when stationary.

20. An automated system for maximizing cell and/or tissue engineering production, the system comprising an automated carousel of any one of items 1 to 19 supported within a vertical housing and operationally connected to one or more controllers for control of translation movement by a user and precise ergonomic positioning of the biological unit for inspection thereof.

21. The system of item 20, comprising a plurality of the automated carousels arranged in series.

21. An automated carousel system for the distribution and ergonomic positioning of multiple biological production units each of the units comprising an automated individually operable cell and/or tissue culture system, the automated carousel system comprising:

an automated carousel comprising:

- a vertical track assembly comprising a drive track and a support track vertically offset therefrom;

- a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered biological production unit, wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological production unit with respect to gravity, and separately, (ii) axial rotation of each biological production unit;

- means for independent biological control of each cell and/or tissue culture system within each of said biological production units;

- a vertical housing assembly supporting the carousel, the housing assembly comprising a central source of operational resources;

- means for interconnecting the central source of operational resources to each successive biological production unit; and

computer connection.

22. The automated carousel system of item 21, wherein each biological production unit comprises a connected interface for communication by a user, said connected interface connected to the computer.

23. The automated carousel system of item 21 or 22, wherein the upright frame comprises up to 24 translation assemblies.

24. The automated carousel system of item 21, wherein the vertical housing assembly comprises a base with retractable wheels.

25. A method for maximizing cell and/or tissue engineering production, the method comprising providing one or more automated carousels system of any one of items 1 to 19 in a production facility.

26. A method for improving ergonomics for users of an automated carousel system that comprises a plurality of independent culture systems each supported within a biological production unit, the method comprising:

mounting a plurality of biological production units on an automated carousel comprising:

- a vertical track assembly comprising a drive track and a support track vertically offset therefrom;

- a plurality of translation assemblies connecting the drive track and the support track at spaced apart positions, each of said plurality of translation assemblies supporting a cantilevered biological production unit, wherein said plurality of translation assemblies is configured for providing (i) translational movement along the connected tracks in unison while maintaining the proper orientation of each cantilevered biological production unit with respect to gravity, and separately, (ii) axial rotation of each biological production unit;

wherein (i) and (ii) is user controlled for ergonomic access to each biological production unit by a user.