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PREVIEW FUNCTION FOR CONTINUOUS LATERAL ROTATION THERAPY

Abstract

A patient support apparatus may include a patient support surface including a rotation device. A controller may be operable to control the rotation device. The controller may include a processor and a non-transitory memory device. The memory device may include instructions that, when executed by the processor, cause the processor to operate the rotation device to perform a rotation preview sequence. During the rotation preview sequence, the controller may cause the rotation device to move the patient support surface to a first evaluation position for a first predetermined period of time.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of U.S. patent application Ser. No. 17/318,419, filed May 12, 2021, and now issued as U.S. Pat. No. _____, which claims priority under 35 U.S.C. § 119(e) to U.S. Provisional Application No. 63/036,706, filed Jun. 9, 2020, both of which are expressly incorporated by reference herein.

TECHNICAL FIELD

[0002] The present disclosure relates to a system and method for controlling patient support surfaces. More particularly, the present disclosure relates to a system and method for previewing control parameters for rotational therapy on a patient support surface.

BACKGROUND

[0003] Currently, caregivers face significant challenges taking care of patients on patient support surfaces with therapy needs. Often patient therapy includes lateral rotation of the patient support surface for patients needing pulmonary therapy or decubitus prevention or treatment. The patient support surface typically includes a mattress that is laterally rotated by an air support system having a plurality of air bladders including include a right rotation bladder and a left rotation bladder. A pneumatic control system includes an air handling unit that is mounted to a base of the bed and a control device mounted, for example, to an end rail or side rail of the bed. The rotation bladders are inflated and deflated to rotate the patient support surface to a left or right angle.

[0004] Generally, the patient on the support surface is coupled to several lines, for example, an IV or an air tube of a respirator device. As the air bladders of the patient support surface are actuated to rotate the patient, the patient's lines may become pinched or caught in various moveable components of the bed or by appendages of the patient themselves. For example, the line may be caught under the leg or arm of the patient. In another example, the line may be caught between the patient and the side rail. Such events may result in the fluids in the lines becoming occluded or the lines becoming entirely disconnected.

SUMMARY

[0005] The present application discloses one or more of the features recited in the appended claims and/or the following features which, alone or in any combination, may comprise patentable subject matter.

[0006] According to a first aspect of the disclosed embodiments, a patient support apparatus may include a patient support surface including a rotation device. A controller may be operable to control the rotation device. The controller may include a processor and a non-transitory memory device. The memory device may include instructions that, when executed by the processor, cause the processor to operate the rotation device to perform a rotation preview sequence. During the rotation preview sequence, the controller may cause the rotation device to move the patient support surface to a first evaluation position for a first predetermined period of time. The first predetermined period of time may enable the caregiver to assess a patient on the patient support surface at the first evaluation position. The rotation device may move the patient support surface to a flat position after the first predetermined period of time. During the first predetermined period of time, the caregiver may be enabled to cancel the rotation preview sequence so that the controller returns the patient support surface to the flat position before the expiration of the first predetermined period of time. After the rotation preview sequence, the caregiver may be enabled to

activate a rotation sequence to move the patient support surface to a desired angle of rotation over a rotation period of time that is greater than the first predetermined period of time.

[0007] In some embodiments of the first aspect, the rotation device may include a left rotation bladder and a right rotation bladder. The first evaluation position may include at least one of a left rotation position, wherein the left rotation bladder is inflated to a capacity greater than the right rotation bladder, and a right rotation position, wherein the right rotation bladder is inflated to a capacity greater than the left rotation bladder. In the flat position, the right rotation bladder and the left rotation bladder may be inflated to substantially the same capacity. The first evaluation position may have an angle of rotation relative to a longitudinal axis of the patient support surface that is within a range of 1 degree to 40 degrees. The first predetermined period of time may be within a range of 0 seconds to 30 seconds.

[0008] It may be desired, in the first aspect, that, during the rotation preview sequence, the rotation device may move the patient support surface to a second evaluation position for a second predetermined period of time. The second predetermined period of time may begin at an expiration of the first predetermined period of time. The second predetermined period of time may enable the caregiver to assess the patient on the patient support surface at the second evaluation position. The second evaluation position may have an angle of rotation that is substantially zero. The second predetermined period of time may be within a range of 0 seconds and 30 seconds.

[0009] It may be contemplated, in the first aspect, that, during the rotation preview sequence, the rotation device may move the patient support surface to a third evaluation position for a third predetermined period of time. The third predetermined period of time may begin at an expiration of the second predetermined period of time. The third predetermined period of time may enable the caregiver to assess a position of a patient on the patient support surface at the third evaluation position. The rotation device may move the patient support surface to the flat position after the third predetermined period of time. During the third predetermined period of time, the caregiver may be enabled to cancel the rotation preview sequence so that the controller returns the patient support surface to the flat position before an expiration of the third predetermined period of time. The third evaluation position may have an angle of rotation relative to a longitudinal axis of the patient support surface that is within a range of 1 degree to 40 degrees. The third predetermined period of time may be within a range of 0 seconds and 30 seconds.

[0010] Optionally, in the first aspect, a display may include buttons for the caregiver to enter initial rotation parameters prior to the start of the rotation preview sequence. The initial rotation parameters may include the desired angle of rotation. During a training preview the control system may cause intermittent movement of the rotation device to the desired angle of rotation over a plurality of periods of time.

[0011] According to a second aspect of the disclosed embodiments, a patient support apparatus may include a patient support surface including a rotation device. A controller may be operable to control the rotation device. The controller may include a processor and a non-transitory memory device. The memory device may include instructions that, when executed by the processor, cause the processor to operate the rotation device to perform a rotation preview sequence. During the rotation preview sequence, the controller may cause the rotation device to move the patient support surface to a plurality of evaluation positions for at least one predetermined period of time. The at least one predetermined period of time may enable the caregiver to assess a position of a patient on the patient support surface at the plurality of evaluation positions. The rotation device may move the patient support surface to a flat position after the predetermined periods of time. During the predetermined periods of time, the caregiver may be enabled to cancel the rotation preview sequence so that the controller returns the patient support surface to the flat position before the expiration of the predetermined periods of time. After the rotation preview sequence, the caregiver may be enabled to activate a rotation sequence to move the patient support surface to a desired angle of rotation over a rotation period of time that is greater than the predetermined periods of

time.

[0012] In some embodiments of the second aspect, the rotation device may include a left rotation bladder and a right rotation bladder. The plurality of evaluation positions may include a left rotation position, wherein the left rotation bladder is inflated to a capacity greater than the right rotation bladder, and a right rotation position, wherein the right rotation bladder is inflated to a capacity greater than the left rotation bladder. In the flat position, the right rotation bladder and the left rotation bladder may be inflated to substantially the same capacity. At least one of the plurality of evaluation positions has an angle of rotation relative to a longitudinal axis of the patient support surface that is within a range of 1 degree to 40 degrees. At least one of the plurality of evaluation positions has an angle of rotation relative to a longitudinal axis of the patient support surface that is substantially zero. At least one of the predetermined periods of time may be within a range of 0 seconds to 30 seconds.

[0013] Optionally, in the second aspect, a display may include buttons for the caregiver to enter initial rotation parameters prior to the start of the rotation preview sequence. The initial rotation parameters may include the desired angle of rotation. During a training preview the control system may cause intermittent movement of the rotation device to the desired angle of rotation over a plurality of periods of time.

[0014] According to a third aspect of the disclosed embodiments, a method of previewing lateral rotation in a patient support apparatus may include actuating a rotation preview sequence. During the rotation preview sequence, a rotation device of a patient support surface may be actuated to move the patient support surface to a first evaluation position for a first predetermined period of time. The first predetermined period of time may enable the caregiver to assess a patient on the patient support surface at the first evaluation position. The method may also include actuating the rotation device to move the patient support surface to a flat position after the first predetermined period of time. The method may also include prompting a caregiver to cancel the rotation preview sequence, during the first predetermined period of time, so that the patient support surface returns to the flat position before the expiration of the first predetermined period of time. The method may also include prompting the caregiver to activate a rotation sequence, after the rotation preview sequence, to move the patient support surface to a desired angle of rotation over a rotation period of time that is greater than the first predetermined period of time.

[0015] In some embodiments of the third aspect, the rotation device may include a left rotation bladder and a right rotation bladder. The first evaluation position may include at least one of a left rotation position, wherein the method includes inflating the left rotation bladder to a capacity greater than the right rotation bladder, and a right rotation position, wherein the method includes inflating the right rotation bladder to a capacity greater than the left rotation bladder. In the flat position, the method may include inflating the right rotation bladder and the left rotation bladder to substantially the same capacity. The method may also include actuating the rotation device to an angle of rotation relative to a longitudinal axis of the patient support surface that is within a range of 1 degree to 40 degrees in the first evaluation position. The method may also include actuating the rotation device for a first predetermined period of time that is with a range of 0 seconds to 30 seconds.

[0016] Optionally, in the third aspect, the method may also include actuating the rotation device to move the patient support surface to a second evaluation position for a second predetermined period of time. The second predetermined period of time may begin at an expiration of the first predetermined period of time. The second predetermined period of time may enable the caregiver to assess a position of a patient on the patient support surface at the second evaluation position. The method may also include actuating the rotation device to move the patient support surface to the flat position having after the second predetermined period of time. During the second predetermined period of time, the method may also include prompting the caregiver to cancel the rotation preview sequence so that the rotation device returns the patient support surface to the flat

position before the expiration of the second predetermined period of time. The method may also include actuating the rotation device to an angle of rotation relative to the longitudinal axis of the patient support surface that is substantially zero degrees in the second evaluation position. The method may also include actuating the rotation device for a second predetermined period of time that is within a range of 0 seconds and 30 seconds.

[0017] It may be desired, in the third aspect, that the method also includes actuating the rotation device to move the patient support apparatus to a third evaluation position for a third predetermined period of time. The third predetermined period of time may begin at an expiration of the second predetermined period of time. The third predetermined period of time may enable the caregiver to assess a position of a patient on the patient support surface in the third evaluation position. The method may also include actuating the rotation device to move the patient support surface to the flat position having after the third predetermined period of time. The method may also include prompting the caregiver to cancel the rotation preview sequence, during the third predetermined period of time, so that the controller returns the patient support surface to the flat position before the expiration of the third predetermined period of time. The method may also include actuating the rotation device to a third angle of rotation relative to a longitudinal axis of the patient support surface that is within a range of 0 degrees to 40 degrees in the third evaluation position. The method may also include actuating the rotation device for a third predetermined period of time that is within a range of 0 seconds and 30 seconds.

[0018] It may be contemplated, in the third aspect, that the method also includes prompting the caregiver to enter initial rotation parameters prior to the start of the rotation preview sequence. The initial rotation parameters may include the desired angle of rotation.

[0019] According to a fourth aspect of the disclosed embodiments, a patient support apparatus may include a patient support surface including a rotation device. A graphical user interface may include a display. A control system may be operable to control the rotation device and the display. The control system may include a non-transitory memory device. The memory device may include instructions that, when executed enable the display to display at least one preview input, which, when selected, enables the control system to cause the rotation device to move the patient support surface to a desired angle of rotation for a preview period of time. The preview period of time may enable the caregiver to assess a patient on the patient support surface at the selected angle. The instructions, when executed, may also enable the display to display a start input which, when selected, enables the control system to cause the rotation device to move the patient support surface to the desired angle of rotation for a full therapy period of time that is greater than the preview period of time.

[0020] In some embodiments of the fourth aspect, the instructions, when executed, may enable the display to display a cancel input which, when selected, enabled the control system to cancel movement of the rotation device to return the patient support surface to a flat position. The desired angle of rotation may be within a range of 1 degree to 40 degrees. The preview period of time may be within a range of 0 seconds to 30 seconds.

[0021] Optionally, in the fourth aspect, the instructions, when executed, may enable the display to display a training input which, when selected, enabled the control system to cause the intermittent movement of the rotation device to the desired angle of rotation over a plurality of periods of time. The rotation device may be moved to 50% of the desired angle of rotation over a first of the plurality of periods of time. The rotation device may be moved to an additional 10% of the desired angle of rotation over a second of the plurality of periods of time. The second of the plurality of periods of time may occur one hour after the first of the plurality of periods of time.

[0022] According to a fifth aspect of the disclosed embodiments, a patient support apparatus may include a patient support surface including a moving section. A controller may be operable to control the moving section. The controller may include a processor and a non-transitory memory device. The memory device may include instructions that, when executed by the processor, cause

the processor to operate the moving section to perform a movement preview sequence. During the movement preview sequence, the controller may cause the moving section to move the patient support surface to a plurality of evaluation positions for at least one predetermined period of time. The at least one predetermined period of time enables the caregiver to assess a position of a patient on the patient support surface at the plurality of evaluation positions. The moving section may move the patient support surface to a flat position after the predetermined periods of time. After the movement preview sequence, the caregiver may be enabled to activate a movement sequence to move the patient support surface to a desired position over a movement period of time that is greater than the predetermined periods of time.

[0023] In some embodiments of the fifth aspect, during the at least one predetermined period of time, the caregiver may be enabled to cancel the movement preview sequence so that the controller returns the patient support surface to the flat position before an expiration of the first predetermined period of time. The least one predetermined period of time may be within a range of 0 seconds to 30 seconds. A display may include buttons for the caregiver to enter initial movement parameters prior to the start of the movement preview sequence. The initial movement parameters may include the desired position.

[0024] Optionally, in the fifth aspect, the moving section may include a left rotation bladder and a right rotation bladder. The plurality of evaluation positions may include a left rotation position, wherein the left rotation bladder is inflated to a capacity greater than the right rotation bladder, and a right rotation position, wherein the right rotation bladder is inflated to a capacity greater than the left rotation bladder. In the flat position, the right rotation bladder and the left rotation bladder may be inflated to substantially the same capacity.

[0025] Additional features, which alone or in combination with any other feature(s), including those listed above and those listed in the claims, may comprise patentable subject matter and will become apparent to those skilled in the art upon consideration of the following detailed description of illustrative embodiments exemplifying the best mode of carrying out the invention as presently perceived.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The detailed description particularly refers to the accompanying figures in which:

[0027] FIG. 1 is a perspective view of a hospital bed system including the touch screen control system for lateral rotation of the bed support surface according to the present disclosure;

[0028] FIG. 2 is a block schematic diagram of the touch screen control system;

[0029] FIG. 3 is an end view of the support surface shown in FIG. 1 illustrating the rotation of the support surface with the left side lifted;

[0030] FIG. 4 is an end view of the support surface shown in FIG. 1 illustrating the support surface in a flat position;

[0031] FIG. 5 is an end view of the support surface shown in FIG. 1 illustrating the rotation of the support surface with the right side lifted;

[0032] FIG. 6 is a flow chart illustrating an algorithm that executes a preview routine;

[0033] FIG. 7 is a flow chart illustrating an algorithm that executes a preview subroutine of the preview routine;

[0034] FIG. 8 is a flow chart illustrating an algorithm that executes an evaluation subroutine;

[0035] FIG. 9 is a view of a user interface for controlling lateral rotation of the support surface of the patient support apparatus;

[0036] FIG. 10 is a view of a “Therapy” screen displayed on the user interface;

[0037] FIG. 11 is a view of a “Rotation Set-up” screen displayed on the user interface;

[0038] FIG. **12** is a view of a “Settings” screen displayed on the user interface;
[0039] FIG. **13** is a view of a “Parameters” screen displayed on the user interface;
[0040] FIG. **14** is a view of an “Options” screen displayed on the user interface;
[0041] FIG. **15** is a view of a “Preview Options” screen displayed on the user interface;
[0042] FIG. **16** is a view of a “Verification” screen displayed on the user interface;
[0043] FIG. **17** is a view of a “Preview” screen displayed on the user interface;
[0044] FIG. **18** is a view of a “Stop Turn” screen displayed on the user interface;
[0045] FIG. **19** is a view of a “Preview Complete” screen displayed on the user interface;
[0046] FIG. **20** is a flow chart illustrating an algorithm that executes a preview process in accordance with another embodiment;
[0047] FIG. **21** is a flow chart illustrating an algorithm that executes a preview process in accordance with another embodiment;
[0048] FIG. **22** is a view of a “Parameters screen” displayed on the user interface;
[0049] FIG. **23** is a view of a “Preview Options” screen displayed on the user interface;
[0050] FIG. **24** is a view of a “Rotation Preview” screen displayed on the user interface; and
[0051] FIG. **25** is a view of a “Resume Preview” screen displayed on the user interface.

DETAILED DESCRIPTION

[0052] FIG. **1** illustrates a patient support apparatus, illustrated as a bed **10**, having a patient support surface, illustrated as a mattress **14**. A touch screen control system **12** including a user interface **40** is provided for controlling lateral rotation of the mattress **14**. The bed **10** includes a base frame **16**, an intermediate frame **20** coupled to the base frame **16** by linkages **18**, and an articulating deck frame **22** that is coupled to the intermediate frame **20** and that supports the mattress **14**. The bed **10** also includes a head end **24**, a foot end **26**, a left side rail **28**, and a right side rail **30**. A longitudinal axis **80** extends from the head section **24** to the foot end **26**. The deck frame **22** includes separate sections that articulate relative to the base frame **16** and relative to each other, for example, a mattress center section **36** that is height adjustable, and a mattress head section **32** and a mattress foot section **34** that are adjustable in elevation relative to the mattress center section **36**. A patient control panel **38** is used to control articulation of the deck frame **22**.
[0053] FIG. **2** illustrates the control system **12** and its interaction with the mattress **14**. The control system **12** includes the user interface **40**, an electrical control system **42**, and a pneumatic control system **46**. The electrical control system **42** includes a controller **60**, a microprocessor **62**, and a memory device **64**. The electrical control system **42** is electrically coupled to the user interface **40** and the pneumatic control system **46**. The memory device **64** includes instructions that, when carried out by the microprocessor **62** cause the controller **60** to control the control system **42** and the pneumatic control system **46**.

[0054] The mattress **14** includes a rotation device, for example, a bladder system **47** having a right rotation bladder **48** and a left rotation bladder **50** that provides positioning and/or therapy, for example, rotational therapy, percussion therapy, vibration therapy, and positioning to assist turning of the patient. The control system **12** controls the right rotation bladder **48** and a left rotation bladder **50** by receiving user inputs at the user interface **40**. The electrical control system **42** controls and monitors the pneumatic control system **46** based on the user inputs. The user interface **40** provides a graphical interface for setting and monitoring the electrical control system **42** and the pneumatic control system **46**, which in turn actuate pneumatic aspects of the right rotation bladder **48** and a left rotation bladder **50**. The pneumatic control system **46** is coupled to the right rotation bladder **48** and the left rotation bladder **50** by pneumatic lines **52**. Additionally, pressure sensors (not shown) or alternative type sensors such as capacitive, inductive, or optical sensors, may also provide feedback control of the bladders **48** and **50** to the pneumatic control system **46** or the electrical control system **42**.

[0055] The pneumatic control system **46** generally provides pressure or vacuum to, or sealing of the pneumatic lines **52** in order to selectively inflate, deflate, or maintain the inflation of the

bladders **48** and **50**. For example, to rotate a patient on the mattress **14** toward the right relative to a longitudinal axis **80** of the mattress **14**, the pneumatic control system **46** actuates the right rotation bladder **48** located under the patient's right side to a volume or capacity that is less than a volume or capacity of the left rotation bladder **50** located under the patient's left side, as illustrated in FIG. **3**. In another example, to rotate a patient on the mattress **14** toward the left relative to the longitudinal axis **80**, the pneumatic control system **46** actuates the left rotation bladder **50** located under the patient's left side to a volume or capacity that is less than a volume or capacity of the right rotation bladder **48** located under the patient's right side, as illustrated in FIG. **5**. To position the patient in a flat orientation, as shown in FIG. **4**, the left rotation bladder **50** and the right rotation bladder **48** are actuated to substantially the same volume or capacity.

[0056] Alternatively, only one of or a portion of the bladders of the bladder system **47** may be actuated by inflation or deflation to laterally rotate a patient on mattress **14** to different rotational positions. Additionally, the bladder system **47** may comprise bladders that are associated with the mattress **14** in an arrangement different from that shown in FIGS. **2-5**, as is known in the art. For example, the bladder system **47** may include vertically stacked bladders, one of which is normally inflated and another that is inflated or deflated to provide rotation. Additionally, the pneumatic control system **46** may also provide other pneumatic control, for example, to provide percussion, vibration, or other desired patient therapy or positioning. The pneumatic control system **46** and the bladder system **47** of mattress **14** may alternatively include a non-pneumatic mechanical or electrometrical control and motion system, or a pneumatic system utilizing movement elements other than bladders.

[0057] When a patient (not shown) is positioned on the mattress **14**, the patient may be coupled to various pieces of equipment (not shown). For example, the patient may be coupled to an intravenous line (IV) or tubes from a respirator device. It will be appreciated that a patient in a healthcare setting may have numerous lines, tubes, and cords connected to the patient. During articulation of the bed **10** or the mattress **14**, these lines may become pinched, caught, or otherwise occluded or disconnected. Accordingly, the embodiments described herein provide a preview of patient positioning when rotational therapy is to be enabled. That is, the embodiments described herein rotate the patient to various evaluation positions for a predetermined period of time so that a caregiver can assess whether any patient lines are occluded or disconnected.

[0058] During rotational therapy, the patient is rotated to desired angles of rotation on each of the right side, left side, and flat for a rotation period of time. For example, the patient may be rotated to 40 degrees to each side for 10 minutes and flat for 10 minutes. Generally, the bladders **48, 50** are actuated over a period of dwell or hold time that enables the patient to slowly be moved into the desired angle of rotation. It will be appreciated that any rotational angle may be desired for any period of time. The preview function of the disclosed embodiments, enables a caregiver to quickly assess whether any lines will be occluded by rotating the patient to the desired angles of rotation without dwell or hold time. That is, the caregiver may assess the patient at a plurality of evaluation positions for predetermined periods of time including a right turn position, a left turn position, and a flat position without waiting for dwell or hold time.

[0059] In an exemplary embodiment, the patient is turned to a right turn position for a right turn predetermined period of time. The right turn predetermined period of time may be any suitable period of time for evaluation, for example, 0 seconds to 30 seconds. During the right turn predetermined period of time, the caregiver assess the patient and the patient lines. If any patient lines are occluded, the caregiver may stop the preview and return the patient to the flat position before expiration of the right turn predetermined period of time. After an expiration of the right turn predetermined period of time, the patient is rotated to the flat position for a flat predetermined period of time. The flat predetermined period of time may be any suitable period of time for evaluation, for example, 0 seconds to 30 seconds. If any patient lines are occluded, the caregiver may stop the preview before expiration of the flat predetermined period of time. After an expiration

of the flat predetermined period of time, the patient is rotated to a left turn position for a left turn predetermined period of time. The left turn predetermined period of time may be any suitable period of time for evaluation, for example, 0 seconds to 30 seconds. If any patient lines are occluded, the caregiver may stop the preview and return the patient to the flat position before expiration of the left turn predetermined period of time.

[0060] The evaluation positions may have an angle of rotation that is the same as the desired angle of rotation. In some embodiments, the angle of rotation of the evaluation positions may be less than or greater than the desired angle of rotation. For example, the angle of rotation for evaluation may be within a range of 0 degrees to 40 degrees. After the expiration of the last predetermined period of time, the patient support apparatus returns to a flat position. At this time, the caregiver may make any necessary adjustments to the patient lines and either perform a second preview or initiate the rotational therapy.

[0061] FIGS. **6-8** illustrate routines for different aspects of an algorithm executed by the microprocessor **62** associated with the controller **60** based on sets of instructions in the memory device **64**. These algorithms enable the caregiver to preview and assess the patient position at various angles of rotation, as set forth above.

[0062] The user interface **40**, illustrated in FIG. **9**, includes a display screen **510** and input buttons **512**, including a “Home” button **514** and up and down arrow buttons **516**, **518**. The caregiver may select a “Therapy” screen **580**, as shown in FIG. **10**, by selecting a “Therapy” button **590** of the user interface. A “Rotation Set-up” screen **610**, shown in FIG. **11**, may be selected by pressing the “Rotation” button **520** of the “Therapy” screen **580** shown in FIG. **10**. The “Rotation” button **520** is used to enter and preview parameters associated with lateral rotation for patients needing pulmonary therapy. For example the “Rotation” button **520** may be utilized to enter the desired angle of rotation for therapy, and/or the rotational time period. Selection of the “Rotation” button **520** results in the “Rotation Set-up” screen **610** appearing on the user interface **40**, as illustrated in FIG. **11**.

[0063] Referring to FIG. **6**, a “Rotation” routine **90** is started, at process step **100**, when the “Rotation Set-up” screen **610** is selected by the caregiver. When the “Rotation Set-up” screen **610** is selected, three buttons are generated and appear on the user interface **40**, at process step **112**. The three buttons include a “Settings” button **612**, a “Therapy” button **614**, and an “Options” button **616**, as illustrated in FIG. **11**. The caregiver may select one of those buttons by providing an input into the controller **60**, and the controller **60**, at decision step **114**, determines which button has been selected. Selection of the “Settings” button **612**, allows for the user to adjust parameters for the rotation therapy as set forth above, and results in the generation of parameter buttons for the entry of program parameters, in process step **116**. The parameter buttons include a “Full” parameter **712**, a “Moderate” parameter **714**, a “Minimum” parameter **716**, and a “Custom” parameter **718**, which are shown in the “Settings” screen **710**, illustrated in FIG. **12**. The controller **60**, at decision step **118**, determines which parameter **712**, **714**, **716**, **718** has been selected. The “Full” parameter **712** enables the user to select a predetermined full rotation, i.e. 40 degrees on left and right. It should be noted that full rotation may include other angles of rotation, for example, an angle of rotation within a range of 35 degrees to 40 degrees. The “Moderate” parameter **714** enables the user to select an angle of rotation that is less than the full angle of rotation, i.e. 20 degrees. It should be noted that moderate rotation may include other angles of rotation, for example, an angle of rotation within a range of 25 degrees to 35 degrees. The “Minimum” parameter **716** enables the user to select an angle of rotation that is less than the moderate angle of rotation, i.e. 10 degrees. It should be noted that minimum rotation may include other angles of rotation, for example, an angle of rotation within a range of 20 degrees to 25 degrees. If the “Custom” parameter **718** is selected, the controller **60** generates buttons to enter custom parameters on a “Parameters” screen **810**, in process step **120**. The custom parameters may include an angle of rotation or a rotation time period. The “Parameters” screen **810**, illustrated in FIG. **13**, enables one of right rotation, center rotation,

and left rotation to be entered in process step **122**. When the entry of the parameters is completed, selection of a “Done” button **818**, returns the user to the “Rotation Set-up” screen **610**, shown in FIG. **11**.

[0064] If the caregiver selects the “Options” button **616** on the “Rotation Set-up” screen **610**, at decision step **114**, the controller **60** generates an “Options” screen **910**, as illustrated in FIG. **14**, that displays a “Training” button **930** and a “Preview” button **920**, at process step **124**. The controller **60**, at decision step **126**, determines which button has been selected. Selection of the “Preview” button **920** results the generation, at process step **128**, of a “Preview” subroutine **750**, as illustrated in FIG. **7**. Selection of the “Training” button **930** results in the generation the “Training” subroutine, at process step **130**. After the “Training” subroutine, the “Rotation” routine **90** ends, at process step **132**.

[0065] In some embodiments, selecting the “Training” button **930** causes the control system to cause the intermittent movement of the rotation device to the desired angle of rotation over a plurality of periods of time. In some embodiments, the rotation device is moved to 50% of the desired angle of rotation over a first of the plurality of periods of time. The rotation device may then be moved to an additional 10% of the desired angle of rotation over a second of the plurality of periods of time. The second of the plurality of periods of time may occur one hour after the first of the plurality of periods of time.

[0066] The “Preview” subroutine **750** allows caregivers to see the rotation settings without waiting for the dwell or hold time, as set forth above. Activating the “Preview” button **920** rotates the patient support surface without dwell or hold time while the patient is on the patient support surface allowing the caregiver to evaluate the settings. The patient support apparatus may be rotated to at least three evaluation positions. These positions include left rotation relative to the longitudinal axis of the patient support apparatus, flat position, and right rotation relative to the longitudinal axis of the patient support apparatus.

[0067] The “Preview” subroutine **750** is illustrated in FIG. **7**. The controller **60**, starts the “Preview” subroutine **750**, at process step **128**, in response to the “Preview button” **920** being selected by the caregiver, at decision step **126** of FIG. **6**. A “Preview Option” screen **1010**, illustrated in FIG. **15**, provides information about the preview process to the user, at process step **210**. A “Continue” button **1012** and a “Cancel” button **1014**, are generated on the “Preview Option” screen **1010** of the user interface **40**, at process step **210**. The controller **60**, at decision step **212**, determines whether the “Continue” button **1012** has been selected. Selection of the “Continue” button **1012**, at decision step **212**, results in the generation, at decision step **216**, of buttons on a “Verification” screen **1110** to verify the entry of initial parameters, as illustrated in FIG. **16**. A caregiver's response to the buttons on the “Verification” screen **1110** ensures that the rotation parameters have been entered prior to the start of the preview process. At decision step **218**, the controller **60**, determines if the initial parameters have been entered. The caregiver may select either a “Yes” button **1114** or a “No” button **1112**. At process step **219**, selection of the “No” button **1112** results in a return of the “Rotation Set-up” screen **610** at process step **110** of the “Rotation” routine **90** illustrated FIG. **6**. The caregiver is then prompted to select one of the three buttons in step **112**.

[0068] Selection of the “Yes” button **1114**, causes the controller **60** to rotate the left side of the mattress **14** of the patient support apparatus **10** through actuation of the bladder system **47**, at process step **220**. A “Preview” screen **1210** of the user interface **40** is illustrated in FIG. **17**. The “Preview” screen **1210** includes a “Stop Turn” button **1212**, a “Continue” button **1012**, and a “Cancel” button **1014**. An “Evaluation” subroutine **752**, illustrated in FIG. **8**, is implemented at process step **222**. The mattress **14** of the patient support apparatus **10** is rotated to the left side during a left turn evaluation period for the left turn predetermined time. During the left turn predetermined time, the caregiver has an opportunity to examine all the external cords associated with the apparatus and ensure that all cords and attachments are in functional order. Furthermore, in

some instances the weight of the patient may prevent from the air bladders from inflating according to the rotation angle specified by the parameter settings. In those cases, the caregiver may evaluate the rotation of the mattress and alter the parameter setting during this preview phase.

[0069] During the “Evaluation” subroutine **752**, the “Continue” button **1012** and the “Stop Turn” button **1212**, are monitored by the controller **60**, at process step **310**. Selection of the “Continue” button **1012**, at decision step **312**, causes the “Evaluation” subroutine **752** to complete the evaluation, at process step **314**. Selection of the “Stop Turn” button **1212**, at decision step **312**, causes the rotation of the surface of the patient support apparatus **10** to stop, at process step **316**. A “Stop Turn” screen **1310**, as illustrated in FIG. **18**, generates a “Cancel” button **1014** and a “Continue” button **1012** on the user interfaces **40**, at process step **318**. Selection of the “Cancel” button **1014**, at decision step **320**, results in the controller **60** causing the patient to rotate back to the center through actuation of the bladder system **47**, at process step **322**. This ensures that the patient moved back to a position where the patient's back is parallel to the ground. The controller **60**, at process step **324**, ends the “Evaluation” subroutine **752** and exits from the “Preview” subroutine **750**.

[0070] If the “Cancel” button **1014** is not selected by the caregiver at decision step **320**, the controller **60** determines if the “Continue” button has been selected, at decision step **326**. Selection of the “Continue” button **1012**, at decision step **326**, results in the continuation of the “Preview” subroutine **750** at the current evaluation step, at process step **328**. At decision step **330**, if the controller **60** determines that a threshold time, i.e. the left turn predetermined time, has not been exceeded, the “Preview” subroutine **750** is continued from the current point of evaluation. The caregiver may select the “Cancel” button **1014** at any time. If the “Cancel” button **1014** is selected, at decision step **332**, the controller **60** rotates the patient back to the center through actuation of the bladder system **47**, at process step **334**. The controller **60** exits the “Preview” subroutine **750** at the current point of the “Evaluation” subroutine **752**, at process step **336**. If the “Cancel” button **1014** is not selected at decision step **332** and the threshold time has not been exceeded, the “Preview” subroutine **750** is continued at the current point of the “Evaluation” subroutine **752** that is being executed.

[0071] If the controller **60** determines that no input has not been selected at decision step **312**, the controller **60** determines whether the threshold time has been exceeded, at decision step **338**. If the threshold time is not exceeded, at process step **340**, the controller **60** awaits an input from the caregiver. The threshold time is continuously monitored, and once that time is exceeded, the patient is rotated back to the center by through actuation of the bladder system **47**, at process step **342**.

[0072] Following the rotation of the patient on the surface of the patient support apparatus **10** to the center, the “Evaluation” subroutine **752** is again implemented, at process step **226** of “Preview” subroutine **750**. After the implementation of the “Evaluation” subroutine **752**, the controller **60** determines if the “Evaluation” subroutine **752** is completed, and the patient is rotated to the right side for a right turn predetermined time through actuation of the bladder system **47**, at process step **228**. Following the rotation of the surface of the patient support apparatus **10** to the right side, the “Evaluation” subroutine **752** is again implemented, at process step **230**. The controller **60**, at decision step **232**, determines if the “Evaluation” subroutine **752** of the right side is completed, and then and rotates the patient back to the center through actuation of the bladder system **47**. Notably, between evaluating the right turn and the left, the patient may be placed in the flat position for the flat predetermined period of time, so that the patient and patient lines may be assessed when moving from the right turn to the left turn. At process step **234**, the controller **60** generates a “Preview” Complete screen **1410**, as illustrated in FIG. **19**.

[0073] The controller **60**, at decision step **236**, determines if the “Yes” button **1114** or “No” button **1112** is selected. Selection of the “Yes” button **1114** causes the reappearance of the “Rotation Set-up” screen **610** on the user interface **40**, at process step **238**. Selection of the “No” button **1112** results in the continuation of the preview process, at process step **240**. At process step **242**, the

duration of the time that the preview process is ongoing is continuously determined. If the time exceeds a certain threshold time determined previously by the caregiver, the controller **60** causes the patient to rotate back to the center through actuation of the bladder system, at process step **244**. This ensures that the patient is moved back to a position such that the patient's back is parallel to the ground, and that the patient is not left rotated to the left or right for an extended period of time. The "Preview" subroutine **750** is then exited, at process step **246**. At decision step **242**, if the controller **60** determines that the threshold time has not been exceeded, the preview subroutine is continued until the controller **60** determines that the threshold time has been exceeded.

[0074] At decision step **212**, if the "Continue" button **1012** is not selected, the controller **60** determines if the "Cancel" button **1014** has been selected, at decision step **214**. Selection of the "Cancel" button **1014** causes the patient to rotate back to the center through actuation of the bladder system **47**, at process step **252**, if the patient is currently rotated to either side. The "Preview" subroutine **750** is exited, at process step **248**. However, if neither the "Continue" button **1012** is selected at decision step **212**, nor the "Cancel" button **1014** is selected at decision step **214**, the controller **60** determines the duration of the time the preview process has been ongoing, at process step **250**.

[0075] If the time exceeds a certain threshold time determined previously by the caregiver, the controller **60** causes the patient to rotate back to the center by rotating the surface of the patient support apparatus **10** to center if the patient is currently rotated to either side, at step process **252**. This ensures that the patient moved back to a position such that the patient's back is parallel to the ground, and that the patient is not left rotated to the left or right for an extended period of time. The "Preview" subroutine **750** is then exited, at process step **248**. At decision step **250**, if the controller **60** determines that the threshold time has not been exceeded, the "Preview" subroutine **750** is continued, and the controller **60** awaits an input from the caregiver, at decision step **254**. The threshold time is continuously monitored, and once that time is exceeded, the controller **60** proceeds to process step **252** and rotates the patient back to the center through actuation of the bladder system **47**.

[0076] The determination of the threshold time is important so that the patient is not left in either the left rotated position or right rotated position for a length of time that is detrimental to patient health. In the instances when the care giver is forced to leave the patient side before completing the preview process, the monitoring of this threshold time ensures that the patient is returned to a flat position within a certain time period.

[0077] After evaluation, the caregiver may select, at decision step **114** of the "Rotation" routine **90**, the "Therapy" button **614** of the "Rotation Set-up" screen **610**, illustrated in FIG. **11**. Accordingly, therapy is started by the controller, at process step **140**, illustrated in FIG. **6**. After the completion of therapy, the "Rotation" routine **90** is ended, at process step **142**.

[0078] Referring now to FIG. **20**, an alternative "Rotation" routine **1700** is started at process step **1702**. The controller **60**, at decision step **1710**, determines if the "Rotation Set-up" screen **610** is selected by the caregiver. Selection of the "Rotation" button **520** results in generation of four buttons for the entry of program parameters, in decision step **1720**. The parameter buttons include a "Full" parameter **712**, a "Moderate" parameter **714**, a "Minimum" parameter **716**, and a "Custom" parameter **718**. In the instance that "Custom" parameter **718** is selected at decision step **1730**, buttons are generated to enter the custom parameters, at decision step **1740**. The "Parameters" screen **1900**, illustrated in FIG. **22**, includes parameters of right rotation, center rotation and left rotation that are entered at decision step **1750**. When the entry of the parameters is completed, selection of the "Next" button, **1902** in decision step **1760**, results in the generation of two buttons, a "Preview" button **2012** and a "Therapy" button **2014**, at process step **1770**, similar to those shown in FIG. **23**. In some embodiment, the "Parameters" screen **1900**, includes a "Preview" button **1912** (not illustrated) and a "Therapy" button **1914** (not illustrated) instead of the "Next" button **1902**, and process step **1770** immediately follows decision step **1750**.

[0079] Selection of the “Start Therapy” button **2216**, at decision step **1780**, results in that input being received by the controller **60** and the therapy being initiated, at process step **1800**. Once therapy is completed, the process is ended, at process step **1810**.

[0080] If the caregiver selects the “Preview” button **2012** at decision step **1780**, the controller **60** starts the “Preview” subroutine **1820** illustrated in FIG. **21**, at step **1830**, and generates the “Rotation Preview” screen **2110** displaying a “Stop Preview” button **2112**, as illustrated in FIG. **24**. At process step **1840**, the controller **60** monitors the user inputs to determine whether the “Stop Preview” button **2112** has been selected. If no input is entered, at decision step **1850**, the controller **60** continues to decision step **1860** to determine whether a predetermined period of time has expired. If the predetermined period of time has not expired, the controller **60** continues to wait for an input, at process step **1870**. If the predetermined period of time has expired, the controller **60** moves the patient back to the flat position, at process step **1880**, and the preview is ended, at process step **1890**.

[0081] If the “Stop Preview” button **2112** is selected, at decision step **1850**, the controller **60** stops rotation of the mattress **14**, at process step **1900**. At process step **1910**, the controller **60** generates the “Rotation Preview” screen **2210**, illustrated in FIG. **25**. The “Rotation Preview” screen **2210** includes a “Resume Preview” button **2212**, a “Cancel” button **2214**, and a “Start Therapy” button **2216**. At decision step **1920**, the controller **60** determines whether the “Cancel” button **2214** has been selected. If the “Cancel” button **2214** has been selected, the controller **60** generates an alarm, for example, a beep every minute, with the beeps getting louder each minute, at process step **1930**. The controller **60** then determines whether the predetermined period of time has expired, at process step **1940**. If the predetermined period of time has not expired, the beeps continue, at process step **1930**. During this time, the controller **60** determines whether the “Cancel” button **2214** has been selected, at decision step **1960**. If the “Cancel” button **2214** is selected, the controller **60**, at process step **1950**, moves the mattress back to center, and the process ends, at process step **1890**. If the “Cancel” button **2214** is not selected, the controller **60** continues the preview, at process step **1970**. If the predetermined period of time has expired, the controller **60**, at process step **1950**, moves the mattress back to center, and the process ends, at process step **1890**.

[0082] At the decision step **1920**, if the “Cancel” button **2214** is not chosen, the controller **60** determines, at decision step **2000**, whether the “Resume Preview” button **2212** has been selected. If the “Resume Preview” button **2212** is selected, the preview continues, at process step **1970**. If the “Resume Preview” button **2212** is not selected, the controller **60** determines whether the “Start Therapy” button **2216** has been selected, at decision step **2010**. If the “Start Therapy” button **2216** has been selected, the therapy starts, at process step **2020**. At the conclusion of therapy, the process ends, at process step **2030**. If the “Start Therapy” button **2216** is not selected, the controller **60** determines whether two minutes has expired, at decision step **2040**. If two minutes has not expired, the controller **60** continues to wait for an input, at process step **2050**. If two minutes has expired, the controller **60** generates an alarm, for example, a beep every minute, with the beeps getting louder each minute, at process step **1930**.

[0083] Although certain illustrative embodiments have been described in detail above, variations and modifications exist within the scope and spirit of this disclosure as described and as defined in the following claims.

Claims

1-19. (canceled)

20. A patient support apparatus, comprising: a patient support surface including a moving section, and a controller operable to control the moving section, the controller including a processor and a non-transitory memory device, the memory device including instructions that, when executed by the processor, cause the processor to operate the moving section to perform a movement preview

sequence, wherein, during the movement preview sequence, the controller causes the moving section to move the patient support surface to a plurality of evaluation positions for at least one predetermined period of time, wherein the at least one predetermined period of time enables the caregiver to assess a position of a patient on the patient support surface at the plurality of evaluation positions, wherein the moving section moves the patient support surface to a flat position after the predetermined periods of time, and wherein, after the movement preview sequence, the caregiver is enabled to activate a movement sequence to move the patient support surface to a desired position over a movement period of time that is greater than the predetermined periods of time.

21. The patient support apparatus of claim 20, wherein, during the at least one predetermined period of time, the caregiver is enabled to cancel the movement preview sequence so that the controller returns the patient support surface to the flat position before an expiration of the first predetermined period of time.

22. The patient support apparatus of claim 20, wherein: the moving section includes a left rotation bladder and a right rotation bladder, and the plurality of evaluation positions includes a left rotation position, wherein the left rotation bladder is inflated to a capacity greater than the right rotation bladder, and a right rotation position, wherein the right rotation bladder is inflated to a capacity greater than the left rotation bladder.

23. The patient support apparatus of claim 22, wherein, in the flat position, the right rotation bladder and the left rotation bladder are inflated to substantially the same capacity.

24. The patient support apparatus of claim 20, wherein the least one predetermined period of time is within a range of 0 seconds to 30 seconds.

25. The patient support apparatus of claim 20, wherein a display includes buttons for the caregiver to enter initial movement parameters prior to the start of the movement preview sequence.

26. The patient support apparatus of claim 25, wherein the initial movement parameters include the desired position.

27. A method of controlling a patient support surface including a moving section, the method comprising: causing the moving section to move the patient support surface to a plurality of evaluation positions for at least one predetermined period of time, wherein the at least one predetermined period of time enables the caregiver to assess a position of a patient on the patient support surface at the plurality of evaluation positions, moving the patient support surface to a flat position after the predetermined periods of time, and after the movement preview sequence, enabling activation of a movement sequence to move the patient support surface to a desired position over a movement period of time that is greater than the predetermined periods of time.

28. The method of claim 27, further comprising, during the at least one predetermined period of time, enabling caregiver to cancel the movement preview sequence so that the controller returns the patient support surface to the flat position before an expiration of the first predetermined period of time.

29. The method of claim 27, wherein the moving section includes a left rotation bladder and a right rotation bladder, and the plurality of evaluation positions includes: a left rotation position, wherein the method includes inflating the left rotation bladder to a capacity greater than the right rotation bladder, and a right rotation position, wherein the method includes inflating the right rotation bladder to a capacity greater than the left rotation bladder.

30. The method of claim 29, wherein, in the flat position, the method includes inflating the right rotation bladder and the left rotation bladder to substantially the same capacity.

31. The method of claim 27, wherein the least one predetermined period of time is within a range of 0 seconds to 30 seconds.

32. The method of claim 27, wherein the method includes enabling the caregiver to enter initial movement parameters prior to the start of the movement preview sequence.

33. The method of claim 32, wherein the initial movement parameters include the desired position.

34. A controller operable to control a moving section a patient support surface, the controller including a processor and a non-transitory memory device, the memory device including instructions that, when executed by the processor, cause the processor to operate the moving section to perform a movement preview sequence including: causing the moving section to move the patient support surface to a plurality of evaluation positions for at least one predetermined period of time, wherein the at least one predetermined period of time enables the caregiver to assess a position of a patient on the patient support surface at the plurality of evaluation positions, moving the patient support surface to a flat position after the predetermined periods of time, and after the movement preview sequence, enabling activation of a movement sequence to move the patient support surface to a desired position over a movement period of time that is greater than the predetermined periods of time.

35. The controller of claim 34, wherein the movement preview sequence includes, during the at least one predetermined period of time, enabling caregiver to cancel the movement preview sequence so that the controller returns the patient support surface to the flat position before an expiration of the first predetermined period of time.

36. The controller of claim 34, wherein the moving section includes a left rotation bladder and a right rotation bladder, and the plurality of evaluation positions includes: a left rotation position, wherein the movement preview sequence includes inflating the left rotation bladder to a capacity greater than the right rotation bladder, and a right rotation position, wherein the movement preview sequence includes inflating the right rotation bladder to a capacity greater than the left rotation bladder, wherein, in the flat position, wherein the movement preview sequence includes inflating the right rotation bladder and the left rotation bladder to substantially the same capacity.

37. The controller of claim 34, wherein the least one predetermined period of time is within a range of 0 seconds to 30 seconds.

38. The controller of claim 34, wherein the movement preview sequence includes enabling the caregiver to enter initial movement parameters prior to the start of the movement preview sequence.

39. The method of claim 38, wherein the initial movement parameters include the desired position.
