

WHAT IS CLAIMED IS:

1. A method of suturing a prosthetic human implant device by an operator, the method comprising:
 - disposing the prosthetic human implant device on a holder component of an automated suture fixture;
 - directing or providing input to cause the automated suture fixture to position the prosthetic human implant device in a first position;
 - executing a first stitch on the prosthetic human implant device using a first hand of the operator;
 - directing or providing input to cause the automated suture fixture to position the prosthetic human implant device in a second position; and
 - executing a second stitch on the prosthetic human implant device using the first hand of the operator.
2. The method of claim 1, wherein the prosthetic human implant device is a heart valve.
3. The method of claim 1 or 2, wherein said directing or providing input to cause the automated suture fixture to position the prosthetic human implant device in the first position involves directing or providing input to cause the automated suture fixture to move the prosthetic human implant device to a desired focal length from a camera lens of an imaging system.
4. The method of any of claims 1 through 3, further comprising directing or providing input to cause the automated suture fixture to circumferentially rotate the prosthetic human implant device in place, while maintaining at least some portion of an outer surface of the prosthetic human implant device in focus of an imaging system.
5. The method of any of claims 1 through 4, wherein operation of the automated suture fixture provides for reduced physical strain on the operator.

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6. The method of any of claims 1 through 5, further comprising loading a pre-programmed suturing procedure script using one or more processors configured to at least partially control the automated suture fixture.

7. The method of any of claims 1 through 6, further comprising performing a pre-punch on the prosthetic human implant device using a handheld tool operated by a second hand of the operator.

8. The method of claim any of claims 1 through 7, wherein the prosthetic human implant device comprises an outside surface and an inside surface defining an at least partially open inside cylinder cavity.

9. The method of claim 8, wherein the first stitch is an outside-to-inside stitch executed by puncturing a needle through the outside surface to the inside cylinder cavity, and the second stitch is an inside-to-outside stitch executed by puncturing the inside surface.

10. The method of claim 9, wherein the first position presents the outside surface to the operator and the second position presents the inside surface to the operator.

11. A method of training a suture assistance system, the method comprising:
manipulating a position of an automated suture fixture to a first desired position;
storing first data that indicates the first desired position;
manipulating the position of the automated suture fixture to a second desired position; and
storing second data that indicates the second desired position, wherein the second data is stored in association with the first data.

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12. The method of claim 11, further comprising:
generating the first data at least in part by capturing position information indicative of the first desired position when the automated suture fixture is in the first desired position; and
generating the second data at least in part by capturing position information indicative of the second desired position when the automated suture fixture is in the second desired position.
13. The method of claim 11 or 12, wherein said manipulating the position of the automated suture fixture involves manually manipulating the automated suture fixture.
14. The method of any of claims 11 through 13, wherein said manipulating the position of the automated suture fixture to the first desired position involves manually manipulating an arm component of the automated suture fixture.
15. The method of any of claims 11 through 14, wherein said manipulating the position of the automated suture fixture to the first desired position involves inputting positioning information using a user input device.
16. The method of claim 15, wherein the user input device is a joystick device.
17. The method of any of claims 11 through 16, further comprising, after said manipulating the position of the automated suture fixture to the first desired position, providing user input to trigger said storing the first data.
18. The method of claim 17, wherein providing the user input involves pressing a foot pedal.
19. The method of any of claims 11 through 18, further comprising focusing a camera on a suture target device held by the automated suture fixture when the automated suture fixture is in the first desired position, wherein the first data indicates a focus setting of the camera.

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20. The method of claim 19, wherein the camera remains focused on the suture target device when the automated suture fixture is in the second position without adjustment of the camera's position or focus.

21. The method of any of claims 11 through 20, further comprising:
positioning a camera to a first position when the automated suture fixture is in the first desired position; and
positioning the camera to a second position when the automated suture fixture is in the second desired position;
wherein the first data indicates the first position of the camera and the second data indicates the second position of the camera.

22. A suturing assistance system comprising:
an automated suture fixture comprising a plurality of motorized actuator devices and a suture target holder, the automated suture fixture being configured to rotate a target suture device mounted to the holder;
a camera system configured to generate an enlarged image of the target suture device; and
a suture target display configured to display the enlarged image, the suture target display indicating a target suture position associated with the target suture device.

23. The suturing assistance system of claim 22, wherein the target suture device is a heart valve.

24. The suturing assistance system of claim 22 or 23, further comprising a controller configured to direct the camera system to capture image data associated with a suturing procedure and store the image data with metadata identifying at least one of the suturing procedure and an operator associated with the suturing procedure.

25. The suturing assistance system of any of claims 22 through 24, wherein the automated suture fixture is configured to adjust a tension of the automated suture fixture.

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26. The suturing assistance system of claim 25, wherein the automated suture fixture includes a pressure plate component configured to adjust the tension of the automated suture fixture.

27. The suturing assistance system of any of claims 22 through 26, wherein the suture target display comprises a reticle.

28. The suturing assistance system of claim 27, wherein the reticle comprises crosshairs.

29. The suturing assistance system of claim 27, wherein the reticle comprises a circular reticle.

30. The suturing assistance system of claim 29, wherein the circular reticle includes notches for stitch counting.

31. The suturing assistance system of claim 27, wherein the reticle comprises a ruler.

32. The suturing assistance system of any of claims 22 through 31, wherein the suture target display is configured to display suturing instructions in connection with a suturing procedure.

33. The suturing assistance system of any of claims 22 through 32, wherein the system provides for reduced physical strain on an operator thereof compared to dual-handheld suturing procedures.

34. The suturing assistance system of any of claims 22 through 33, wherein the target suture device holder is a gimbal holder assembly.

35. The suturing assistance system of claim 34, wherein the gimbal holder assembly comprises a three-axis gimbal.

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36. The suturing assistance system of any of claims 22 through 35, wherein the automated suture fixture is configured to move the target suture device in at least four directions.

37. The suturing assistance system of any of claims 22 through 36, wherein the automated suture fixture comprises a plurality of servo motor devices daisy-chained together.

38. The suturing assistance system of claim 37, wherein the plurality of servo motor devices are configured to be mounted either horizontally or vertically.

39. The suturing assistance system of any of claims 22 through 38, wherein the camera system comprises a first camera and a second camera, the first and second cameras collectively configured to provide images of two different views of the target suture device.

40. The suturing device of any of claims 22 through 39, wherein the automated suture fixture comprises an encoder associated with an articulation arm, the encoder configured to provide position information for the articulation arm.

41. An automated suture fixture comprising:

a plurality of motorized actuator devices, each comprising a motor and a rotating support member coupled to a rotor component of the motor; and

a suture target holder assembly attached to the rotating support member of a distal actuator device of the plurality of motorized actuator devices and configured to hold a prosthetic heart valve device;

wherein each of the plurality of motorized actuator devices is fixed to one or more other motorized actuator devices of the plurality of motorized actuator devices; and

wherein the automated suture fixture is configured to receive control signals and rotate the rotating support members of one or more of the plurality of motorized actuator devices based on the control signals.

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42. The automated suture fixture of claim 41, wherein each of the plurality of motorized actuator devices further comprises a servo feedback component configured to generate a signal indicating a position of a respective rotor component.

43. The automated suture fixture of claim 42, wherein the servo feedback component is a digital encoder.

44. The automated suture fixture of claim 42 or 43, wherein the plurality of motorized actuator devices comprises one or more base actuator devices and at least one intermediate-stage actuator device fixed at a base thereof to the rotating support members of the one or more base actuator devices, wherein the distal actuator device is fixed at a base thereof to the rotating support member of the intermediate-stage actuator device.

45. The automated suture fixture of claim 44, wherein the base of the intermediate-stage actuator device is fixed to the rotating support members of the one or more base actuator devices via a connector plate mounted to the rotating support members of the one or more base actuator devices.

46. The automated suture fixture of claim 44 or 45, wherein the rotating support members of the one or more base actuator devices are fixed to one another.

47. The automated suture fixture of any of claims 44 through 46, wherein the one or more base actuator devices consists of one motorized actuator device.

48. The automated suture fixture of any of claims 44 through 47, wherein the one or more base actuator devices consists of two motorized actuator devices.

49. The automated suture fixture of any of claims 42 through 48, wherein the suture target holder assembly comprises one or more components configured to rotate about an axis substantially tangent to an axis of rotation of the rotating support member of the distal actuator device.

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50. A suturing assistance system comprising:
an automated suture fixture comprising a plurality of motorized actuator devices and a suture target holder, the automated suture fixture being configured to position a target suture device mounted to the holder;
a data store storing suturing procedure script data, the suturing procedure script data including a data set representing a plurality of positions of the automated suture fixture assembly for a suturing procedure; and
a controller configured to access the suturing procedure script data and provide position control signals to the automated suture fixture based at least in part on the suturing procedure script data.
51. The suturing assistance system of claim 50, wherein the target suture device is a prosthetic human heart valve implant device.
52. The suturing assistance system of claim 50 or 51, wherein the controller is further configured to select the data set from among a plurality of data sets of the suturing procedure script data.
53. The suturing assistance system of claim 52, wherein said selecting is based at least in part on operator profile information.
54. The suturing assistance system of claim 52 or 53, wherein said selecting is based at least in part on user input received by the controller.
55. The suturing assistance system of any of claims 52 through 54, wherein the plurality of data sets includes a first data set corresponding to a right-handed execution of the suturing procedure and a second data set corresponding to a left-handed execution of the suturing procedure.
56. A method of performing operations on a target device by an operator, the method comprising:
disposing the target device on a holder component of an automated fixture;

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directing or providing input to cause the automated fixture to position the target device in a first position;

executing a first operation on the target device;

directing or providing input to cause the automated fixture to position the target device in a second position; and

executing a second operation on the target device.

57. The method of claim 56, wherein the target device is a prosthetic heart valve.

58. The method of claim 56 or 57, wherein the automated fixture is an automated suture fixture.

59. The method of any of claim 56 through 58, wherein said directing or providing input to cause the automated fixture to position the target device in the first position involves directing or providing input to cause the automated fixture to move the target device to a desired focal length from a camera lens of an imaging system.

60. The method of any of claims 56 through 59, further comprising directing or providing input to cause the automated fixture to circumferentially rotate the target device in place, while maintaining at least some portion of an outer surface of the target device in focus of an imaging system.

61. The method of any of claims 56 through 60, further comprising loading a pre-programmed procedure script using one or more processors configured to at least partially control the automated fixture.

62. The method of any of claims 56 through 61, further comprising performing a pre-punch on the target device using a handheld tool operated by a second hand of the operator.

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63. The method of any of claims 56 through 62, wherein the target device comprises an outside surface and an inside surface defining an at least partially open inside cylinder cavity.

64. The method of claim 63, wherein the first operation is an outside-to-inside stitch executed by puncturing a needle through the outside surface to the inside cylinder cavity, and the second operation is an inside-to-outside stitch executed by puncturing the inside surface.

65. The method of claim 64, wherein the first position presents the outside surface to the operator and the second position presents the inside surface to the operator.

66. A method of training a manufacturing system, the method comprising:
manipulating a position of an automated fixture to a first desired position;
storing first data that indicates the first desired position;
manipulating the position of the automated fixture to a second desired position; and
storing second data that indicates the second desired position, wherein the second data is stored in association with the first data.

67. The method of claim 57, further comprising:
generating the first data at least in part by capturing position information indicative of the first desired position when the automated fixture is in the first desired position; and
generating the second data at least in part by capturing position information indicative of the second desired position when the automated fixture is in the second desired position.

68. The method of claim 66 or 67, wherein said manipulating the position of the automated fixture to the first desired position involves manually manipulating an arm component of the automated fixture.

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69. The method of claim 66 or 67, wherein said manipulating the position of the automated fixture to the first desired position involves inputting positioning information using a user input device.

70. The method of any of claims 66 through 69, further comprising, after said manipulating the position of the automated fixture to the first desired position, providing user input to trigger said storing the first data.

71. The method of any of claims 66 through 69, further comprising focusing a camera on a target device held by the automated fixture when the automated fixture is in the first desired position, wherein the first data indicates a focus setting of the camera.

72. The method of claim 71, wherein the camera remains focused on the target device when the automated fixture is in the second position without adjustment of the camera's position or focus.

73. An assistance system comprising:

an automated fixture comprising a plurality of motorized actuator devices and a target device holder, the automated fixture being configured to rotate a target device mounted to the holder;

a camera system configured to generate an enlarged image of the target device; and

a display configured to show the enlarged image, the display indicating a target operation position associated with the target device.

74. The assistance system of claim 73, wherein the target device is a prosthetic heart valve.

75. The assistance system of claim 73 or 74, wherein the automated fixture is an automated suture fixture.

76. The assistance system of any of claims 73 through 75, further comprising a controller configured to direct the camera system to capture image data associated with

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a procedure and store the image data with metadata identifying at least one of the procedure and an operator associated with the procedure.

77. The assistance system of any of claims 73 through 76, wherein the automated fixture is configured to adjust a tension of the automated fixture, for example, using a pressure plate component configured to adjust the tension of the automated fixture.

78. The assistance system of any of claims 73 through 77, wherein the display shows a reticle, for example, crosshairs, a circular reticle, a ruler, each of which can include notches.

79. The assistance system of any of claims 73 through 78, wherein the display is configured to display instructions for carrying out a procedure or step of a procedure.

80. The assistance system of any of claims 73 through 79, wherein the target device holder is a gimbal holder assembly.

81. The assistance system of any of claims 73 through 80, wherein the automated suture fixture comprises a plurality of servo motor devices daisy-chained together.

82. The assistance system of any of claims 73 through 81, wherein the camera system comprises a first camera and a second camera, the first and second cameras collectively configured to provide images of two different views of the target device.

83. The assistance system of any of claims 73 through 82, wherein the automated fixture comprises an encoder associated with an articulation arm, the encoder configured to provide position information for the articulation arm.

84. The assistance system of any of claims 73 through 83, wherein the automated fixture is configured to move the target device such that a portion of the target device remains in focus with respect to the camera system in each procedure position.

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85. A method of performing an attachment operation on a target device by an operator, the method comprising:

- disposing the target device on a holder component of an automated fixture;
- directing or providing input to cause the automated fixture to position the target device in a first position;
- executing a first attachment operation on the target device;
- directing or providing input to cause the automated fixture to position the target device in a second position; and
- executing a second attachment operation on the target device.

86. The method of claim 85, wherein the target device is a prosthetic heart valve.

87. The method of claim 85 or 86, wherein the automated fixture is an automated suture fixture.

88. The method of any of claim 85 through 87, wherein said directing or providing input to cause the automated fixture to position the target device in the first position involves directing or providing input to cause the automated fixture to move the target device to a desired focal length from a camera lens of an imaging system.

89. The method of any of claims 85 through 88, further comprising directing or providing input to cause the automated fixture to circumferentially rotate the target device in place.

90. The method of any of claims 85 through 89, further comprising loading a pre-programmed procedure script using one or more processors configured to at least partially control the automated fixture.

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91. The method of any of claims 85 through 90, wherein the target device comprises an outside surface and an inside surface defining an at least partially open inside cylinder cavity.

92. The method of any of claims 85 through 91, wherein the attachment operation comprises attaching a skirt to a prosthetic heart valve.