

LIST OF REFERENCE NUMERALS

- [0153] 1. Means for supporting limb
- [0154] 2. Device for detecting force of gravity (force sensor; load cell)
- [0155] 3. Device for negating force of gravity (force generator; actuator)
- [0156] 4. Means for interdispositioning and communicating between detecting device and negating device
- [0157] 5. Support
- [0158] 6. Means for articulating and attaching system to a support
- [0159] 7. Basal substrate (floor, table, etc.)
- [0160] 8. Means for computer processing
- [0161] 9. Power transfer medium
- [0162] 10. Power transfer medium
- [0163] 11. User, subject, or individual
- [0164] 12. Force transducer
- [0165] 13. Force sensor
- [0166] 14. Controller
- [0167] 15. Power transducer
- [0168] 16. Integrated circuit
- [0169] 17. Power transducer
- [0170] 18. Virtual mass
- [0171] 19. Power transducer to servo motor
- [0172] 20. Power transducer to virtual world (virtual environment)
- [0173] 21. Servo motor
- [0174] 22. Force transducer
- [0175] 23. Virtual world (virtual environment)
- [0176] 24. Power transducer
- [0177] 25. Vertical axis of motion
- [0178] 26. Horizontal axis of motion
- [0179] 27. Horizontal axis of motion, unused
- [0180] 28. Rotational arc of motion
- [0181] 29. Robot arm
- [0182] 30. Splint
- [0183] 31. Gimbal
- [0184] 32. JR3 force sensor
- [0185] 33. Dampers
- [0186] 34. Spline
- [0187] 35. Robot base
- [0188] 36. Bottom plate
- [0189] 37. Position sensor
- [0190] 38. Top or mobile plate
- [0191] 39. Upper leg
- [0192] 40. Cylindrical joint
- [0193] 41. Lower leg
- [0194] 42. Lower universal joint
- [0195] 43. Fixed base plate
- [0196] 44. Chair
- [0197] 45. Actuator
- [0198] 46. End effector
- [0199] 47. Y-axis hinge
- [0200] 48. Linkage
- [0201] 49. Display
- [0202] 50. Virtual world display signals
- [0203] 51. Object display (FVP)
- [0204] 52. Subject force, velocity, and position for data acquisition
- [0205] 53. Real time control system (dedicated computer; real time operating system)
- [0206] 54. Motor drive, X-axis
- [0207] 55. Motor drive, Y-axis
- [0208] 56. Motor drive, Z-axis
- [0209] 57. Axis position and velocity signals
- [0210] 58. Axis 1
- [0211] 59. Axis 2
- [0212] 60. Axis 3
- [0213] 61. Additional axes (rotational DOFs; wrist, fingers)
- [0214] 62. Robotic device

EXAMPLES

[0215] The invention will be more readily understood by reference to the following examples, which are included merely for purposes of illustration of certain aspects and embodiments of the present invention and not as limitations.

Example I

Modification of the HAPTICMASTER to Meet Required Specifications

[0216] The required needs for stroke subjects fall well within the performance criteria of the current version of the HAPTICMASTER. Its peak force ability of 250 N is considerably greater than the maximum adduction forces measured in our strongest stroke subjects (Dewald and Beer (2001a) Muscle Nerve 24: 273-283). The position resolution of the HAPTICMASTER device was approximately 4-14 μm . This was more than sufficient for the kinematic measurements needed for the real time visual display (see also rehabilitation software development). The maximum deceleration (50 m/s^2) and simulated stiffness ($50,000 \text{ N/m}$) were also more than sufficient for the mechanical environments we intend to simulate. The only performance criteria that was adjusted was the maximum velocity of the robot which was originally 1.4 m/s, less than the needed 2.25 m/s to