

CLAIMS

1. An actuator device for limb rehabilitation comprising:

one or more pneumatic actuator elements; and

means for coupling the pneumatic actuator elements to the limb at or near one or more joints of the limb;

wherein each pneumatic actuator element comprises:

an expandable main body having a longitudinal axis;

one or more channel networks formed in the main body such that, in an acquiescent state of the pneumatic actuator element, a projected length of each channel network along the longitudinal axis is shorter than a total channel length of said each channel network;

wherein the device is configured for ankle rehabilitation; and

comprising at least two pneumatic actuator elements, wherein the means for coupling the pneumatic actuator elements to the limb is configured to couple the two pneumatic actuator elements on opposite sides of the leg, the device further comprising a guiding fabric coupled at one end thereof to the first pneumatic actuator element and at the other end thereof to the second pneumatic actuator element, the device further comprising a sheath for receiving the foot therein, with the guiding fabric extending substantially around the foot and through the sheath; or

wherein the means for coupling the pneumatic actuator elements to the limb comprises a sock element, the sock element having at least two pneumatic actuator elements embedded therein for disposition at or near opposite sides of the ankle when the sock element is worn.

2. The device as claimed in claim 1, further comprising a restraining layer coupled to the expandable main body for guiding a deformation of the main body caused by inflation of the channel network.

3. The device as claimed in claims 1 or 2, configured for hand rehabilitation.

4. The device as claimed in claim 3, wherein the main body comprises a textured surface for facilitating expansion of the main body caused by inflation of the channel network.

5. The device as claimed in claims 3 or 4, further comprising one or more restraining structures coupled to the main body for substantially inhibiting expansion of the main body in at least a portion thereof.

6. The device as claimed in any one of claims 3 to 5, wherein the means for coupling the pneumatic actuator elements to the limb comprises a glove.

7. The device as claimed in claim 6, wherein at least one pneumatic actuator element is disposed on the dorsal side of the glove.
8. The device as claimed in claims 6 or 7, wherein at least one pneumatic actuator element is disposed on the palmar side of the glove.
9. The device as claimed in any one of claims 6 to 8, wherein pairs of pneumatic actuator elements are disposed at or near each of the joints.
10. The device as claimed in claim 9, wherein one pneumatic actuator of each pair is disposed on the dorsal side of the glove and the other one on the palmar side of the glove.
11. The device as claimed in any one of the preceding claims, comprising a coupled pair of pneumatic actuator elements, wherein the means for coupling the pneumatic actuator elements to the limb comprises a first coupling element for coupling first ends of the pair of pneumatic actuator elements to the foot and a second coupling element for coupling second ends of the pair of pneumatic actuator elements to the leg, such that the pair of pneumatic actuator elements extends across the ankle.
12. The device as claimed in any one of the preceding claims, wherein the sock element comprises two complimentary portions connected by bilateral fastening means such as zippers.
13. The device as claimed in any one of the preceding claims, wherein the device is configured for ankle plantarflexion/dorsiflexion.
14. The device as claimed in and one of the preceding claims, wherein the device is configured for ankle supination/pronation.
15. The device as claimed in any one of the preceding claims, further comprising a sensor for monitoring movement of the one or more joints.
16. A system for limb rehabilitation comprising:
 - a device as claimed in any one of claims 1 to 15;
 - a pump system for selectively inflating and deflating the pneumatic actuator elements;
 - and
 - a controller for the pump system.
17. The system as claimed in claim 16, further comprising a sensor for monitoring movement of the one or more joints.