

CLAIMS

1. An actuator array comprising:
an elongated base, wherein the base comprises a pliant and inextensible material; and
a plurality of pneumatic actuator elements removably attached to the base,
wherein the actuator elements are configured to be inflated and interfere with each other in use to generate a bending motion supported by the base; and
wherein at least one parameter associated with the actuator elements is selected to control a three-dimensional (3-D) profile of the bending motion.
2. The actuator array as claimed in claim 1, wherein the at least one parameter comprises relative sizes of adjacent actuator elements.
3. The actuator array as claimed in claim 1 or 2, wherein the at least one parameter comprises shapes of adjacent actuator elements.
4. The actuator array as claimed in any one of the preceding claims, wherein the at least one parameter comprises a spatial distribution of the actuator elements on the base.
5. The actuator array as claimed in any one of the preceding claims, wherein the at least one parameter comprises relative elasticities of adjacent actuator elements.
6. The actuator array as claimed in any one of the preceding claims, wherein the actuator elements are independently operable.
7. The actuator array as claimed in claim 6, wherein each actuator element comprises a respective valve for controlling an inflation pressure.
8. An exoskeleton comprising at least one actuator array as claimed in any one of the preceding claims, wherein the exoskeleton is configured to be mounted to a user to generate a continuous 3-D trajectory.
9. The exoskeleton as claimed in claim 8, wherein the actuator elements are configured to generate the bending motion adjacent a joint of the user and substantially no bending motion along a body or limb section of the user.

10. The exoskeleton as claimed in claim 8 or 9, comprising at least two actuator arrays connected in series.
11. The exoskeleton as claimed in claim 8 or 9, comprising at least two actuator arrays connected in parallel.
12. The exoskeleton as claimed in claim 11, wherein the at least two actuator arrays are arranged in an antagonistic pattern.
13. The exoskeleton as claimed in any one of claims 8 to 12, wherein the exoskeleton comprises a 2 degree-of-freedom shoulder exoskeleton.
14. The exoskeleton as claimed in any one of claims 8 to 12, wherein the exoskeleton comprises a lower body exoskeleton.
15. The exoskeleton as claimed in any one of claims 8 to 12, wherein the exoskeleton comprises a full body exoskeleton.
16. A method of generating a bending motion, the method comprising:
 - providing an actuator array comprising an elongated base and a plurality of pneumatic actuator elements removably attached to the base, wherein the base comprises a pliant and inextensible material;
 - supplying a pressurized fluid to inflate the actuator elements such that adjacent actuator elements interfere with each other to generate a bending motion, wherein the bending motion is supported by the base; and
 - controlling at least one parameter associated with the actuator elements to control a three-dimensional (3-D) profile of the bending motion.
17. The method as claimed in claim 16, wherein controlling at least one parameter comprises selecting relative sizes of adjacent actuator elements.
18. The method as claimed in claim 16 or 17, wherein controlling at least one parameter comprises selecting shapes of adjacent actuator elements.

19. The method as claimed in any one of claims 16 to 18, wherein controlling at least one parameter comprises selecting a spatial distribution of the actuator elements on the base.
20. The method as claimed in any one of claims 16 to 19, wherein controlling at least one parameter comprises selecting relative elasticities of adjacent actuator elements.
21. The method as claimed in any one of claims 16 to 20, wherein supplying the pressurized fluid to inflate the actuator elements comprises operating the actuator elements independently of one another.
22. A method of mechanically assisting a user, comprising mounting an exoskeleton as claimed in any one of claims 8 to 15 to the user, and operating the at least one actuator array to generate the bending motion.
23. The method as claimed in claim 22, wherein operating the at least one actuator array comprises synchronising inflation of selected actuator elements with a limb or body movement of the user to reduce a load on the user's muscles.
24. A garment article comprising:
at least one actuator array as claimed in any one of claims 1 to 7;
at least one sensor; and
a processor communicatively coupled to the at least one actuator array and the at least one sensor,
wherein the processor is configured to control the bending motion of the at least one actuator array based on an input from the at least one sensor.
25. The garment article as claimed in claim 24, comprising a set of fabric-based overalls.
26. The garment article as claimed in claim 24, comprising a pair of fabric-based shoulder sleeves.