

# Biomechanical Augmentation

Basic wearables like the Fitbit are now commonplace, with many using these devices to optimise activity and health. Soft robotics are also advancing rapidly, and the two technologies are converging. As a result, the next decade should see the emergence of comfortable leisure garments that unobtrusively augment muscle activity, triggered instantly by the wearer's mobility intentions, while also providing comprehensive insights into health and fitness.

## What we're seeing

### Continued growth of wearables

Tech heavyweights like Samsung and Apple are placing significant future focus on wearables as this category is among their fastest-growing sources of revenue and new users. Though currently dominated by wrist fitness trackers, indicators show strong growth in alternates (e.g., digitally connected rings, audio glasses, and wearable patches). [\[arstechnica.com\]](http://arstechnica.com)

### Control systems are becoming more responsive and flexible

Innovative electrochemical actuators will overcome the lag between the wearer's intent and subsequent movement [\[phys.org\]](http://phys.org). Additive manufacturing is now solving the challenge of creating soft robots driven by pressurised fluids. These designs remove the constraints of more rigid robot designs and would enable far more flexible action [\[sciencedaily.com\]](http://sciencedaily.com).

### Enhancing sensation

Using soft robotics and wearables to generate physical feeling will enhance the wearer's game-playing experience and training feedback. New advances in haptic technologies [\[eurasiareview.com\]](http://eurasiareview.com) are already becoming available in the online-gaming world [\[bhaptics.com\]](http://bhaptics.com)

### Connecting the brain to technology

Improving the flow of information from the wearer's brain to the augmenting device requires a highly conductive and flexible interface. The recent development of highly conductive and elastic nanomembranes for 'skin electronics' could revolutionise the human-machine interface (in addition to health monitoring, health diagnosis, virtual reality etc.). [\[ibs.re.kr\]](http://ibs.re.kr)

### Innovative materials are getting lighter, more flexible and stronger

Clothing made of synthetically-derived muscle fibres would enable soft-robotics components stronger than Kevlar to fit like a glove [\[phys.org\]](http://phys.org). Comfortable but strong clothing could be combined with credit card-sized soft pumps to power wearable artificial muscles [\[techxplore.com\]](http://techxplore.com).

### Intelligent e-skins monitoring body function

Wearable motion sensors can now identify the user's bending and twisting motions. They are being considered for applications in healthcare and manufacturing but could equally be applied to sports analysis and training [\[technion.ac.il\]](http://technion.ac.il) Already, flexible carbon nanotube fibres are being woven into garments to monitor the heart rate and take a continual electrocardiogram (EKG) of the wearer [\[phys.org\]](http://phys.org), [\[youtube.com\]](http://youtube.com)

## Implications

### Create

- Individuals will be able to participate in a wider range of physical activity, longer.
- Manual work patterns extended by augmentation.

### Relate

- Initial technology adopted by wealthier cohorts.
- Access to enhancement technologies widens social distance.

### Consume

- New opportunities for innovative physical activities accessed by wider range of people.
- Previously necessary skill or fitness levels may be less of a consideration.

### Degrade

- Dynamic eSport environments enhanced by biomechanics may side-line trad. Sport.
- Drive for personal fitness may decline if augmentation overcomes exercise incentives.

### Connect

- Individuals connecting with their own bodies in unprecedented ways.
- Connected players or fans 'feel' the team dynamic e.g. levels of energy.

### Define

- The boundary of human activity blurred. What is 'natural' performance?
- Will augmented training give an unfair edge?

## More information (links)

- More people are buying wearables than ever before—and Apple is in the lead <https://arstechnica.com/gadgets/2021/05/more-people-are-buying-wearables-than-ever-before-and-apple-is-in-the-lead/>
- A guy with bad knees gets superpowers with a powered exoskeleton. <https://futurism.com/the-byte/knees-powered-exoskeleton>
- Japan's Robot Revolution <https://youtu.be/zKhm89FW0y8?t=891>
- Synthetic biology enables microbes to build muscle <https://phys.org/news/2021-08-synthetic-biology-enables-microbes-muscle.html>
- Credit-card sized soft pumps power artificial muscles <https://techxplore.com/news/2021-02-credit-card-sized-soft-power-wearable.html>
- Researchers use organic semiconductor nanotubes to create a new electrochemical actuator <https://phys.org/news/2021-09-semiconductor-nanotubes-electrochemical-actuator.html>
- Soft components for the next generation of soft robotics <https://www.sciencedaily.com/releases/2021/09/210908180516.htm>