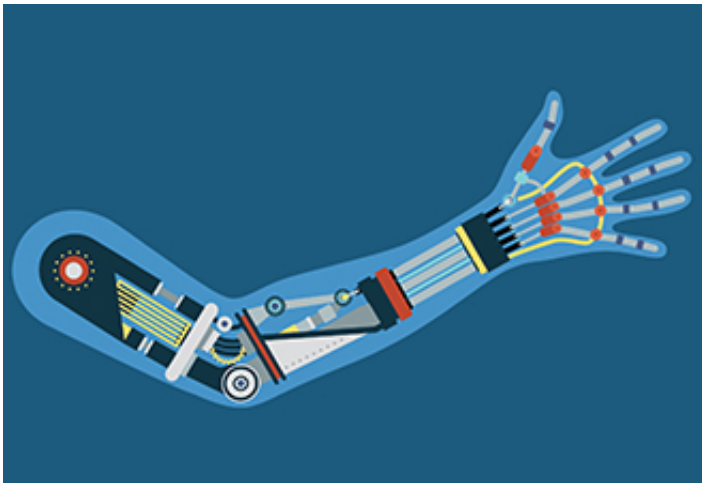


Major gains still to be made in quality of arm prostheses

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Approximately 4,000 people in the Netherlands are affected by arm damage: they have to do without the use of their hand or part of their hand, their forearm or even a complete arm. The majority of these people have a prosthesis. This prosthesis may be purely cosmetic, or have a gripping function, enabling the user to carry out everyday activities. The latter may either be body-powered or myoelectric. A myoelectric prosthesis is controlled by electrical signals associated with the user's muscle contractions, and is powered by electric motors. Body-powered prostheses are controlled by bodily movements. These movements are transmitted to the gripping mechanism via a harness on the shoulder and a cable.

Cyathlon

'In many ways, a body-powered prosthesis is better than a myoelectric version', explains doctoral candidate Mona Hichert. 'This was demonstrated, for example, last year during the CYBATHLON competition in Zurich. In the Powered Arm Prosthesis Race, people carried out [everyday activities](#) using a prosthetic arm. A student team from Delft was the only team to participate using a body-powered prosthesis, and easily won from the big commercial teams.'

Body-powered prostheses are also lighter, cheaper and more reliable, while they also offer the user feedback regarding the movements of the gripping mechanism and the grip force exerted on objects.

Fatigue

'Unfortunately, approximately half of the users are so dissatisfied with their body-powered prosthesis that they avoid actively using it. Existing prostheses require a lot of strength to use them, which can result in pain and fatigue during or after use. Users also complain about the comfort and appearance of the shoulder strap. To cut to the chase: these prostheses need to be improved'.

9 out of 10

During her research, Hichert did indeed demonstrate that existing prostheses demand too much operational force from the user. 'In concrete terms, I have shown that, in the case of 90 per cent of prostheses, more than half of the users report not being able to use the prosthesis for a whole day without experiencing fatigue and pain. This potentially explains why people avoid using their prosthesis. The required amount of force therefore needs to be reduced. When less

operational force is required, people also have greater control of their prosthesis and can manage the gripping strength they apply to objects more effectively'.

Prostheses of the future

In her research, Hichert concludes that in order to allow users to use their prosthesis for the entire day – and every day – without becoming tired, and to enable efficient feedback and control of the gripping mechanism, operational force should not exceed 38 N for the average female user, or 66 N for the average male user. A long operation movement stroke, and hence a large cable excursion, does contribute to increased control of the gripping mechanism. Lowering the required force also makes it possible to replace the shoulder harness with an anchor point, which can be easily applied to the user's back with a sticker.

Delft Cylinder Hand

'Concrete improvements such as this are currently being implemented in the Delft Cylinder Hand (DCH), which resulted from research conducted by Gerwin Smit, my colleague at TU Delft. After being awarded a Veni grant, he is currently researching how prosthetic hands such as the DCH can be made even faster and easier to control'.

Clinics

'My dissertation highlights the problems with commercially-available prostheses, and outlines the areas that prosthetics developers need to address if they want to satisfy the user, so that ultimately, more prostheses are actually used. Finally, I remind clinics that when prescribing a [prosthesis](#), they should pay due consideration to the fact

that not all [prostheses](#) are suitable for all users. After all, my research has demonstrated significant variations in user capacity'.

More information: User Capacities and Operational Forces, Requirements for Body-Powered Upper-Limb Prostheses':
[repository.tudelft.nl/islandor ... ?collection=research](https://repository.tudelft.nl/islandor...?collection=research)

Provided by Delft University of Technology

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