Researcher develops lightest ever prosthetic hand

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Current prostheses for hands have major disadvantages. Researcher Gerwin Smit developed a much improved alternative. On Tuesday 11 June, he will be awarded his PhD at TU Delft for his work on the subject.

Rehabilitation

Replacing a missing human hand by an artificial hand is one of the greatest challenges in the field of rehabilitation. Over 30% of prosthesis users worldwide wear a so-called body-powered prosthesis. This is operated by pulling on a cable (similar to the brake cable on your bike). This cable is attached to a harness worn on your opposite shoulder. Movements between the arm wearing the prosthesis and the opposite shoulder pull the cable taut and close the prosthesis.

Another commonly used prosthesis is the electric prosthesis. This is worn by about 40 % of prosthesis users worldwide. In addition, there are also cosmetic prostheses.

Disadvantages

Although there are a whole variety of prosthetic hands available, 27% of their users do not use the prosthesis actively and more than 20% do not actually use a prosthesis at all. 'There are various reasons for this,' explains PhD candidate Gerwin Smit, 'such as low user comfort (too

heavy, too hot), too few functional advantages and a lack of sensory feedback.'

Therefore things need to be improved and reducing the amount of mass has the highest priority for the user.

Smit: 'It's all about the three Cs: cosmetics, comfort and control. The prosthesis needs to be attractive to look at, comfortable to wear and easy to operate. My objective was to design and test a lightweight and mechanically efficient body-powered prosthetic hand with hinged fingers. A low amount of mass improves comfort, while mechanical efficiency will reduce the operating force required and increase operating comfort. As a result, the hand will also be able to grip more firmly. The hinged fingers enable both the pincer grip and the cylinder grip to be formed, so that a broad range of various objects can be held.'

Hydraulic

Smit compared current prosthetic hands and came up with a promising alternative: a body-powered prosthetic hand with hinged fingers, hydraulically operated with miniature cylinders that are so small they fit inside a finger. The hand is operated through subtle movements of the shoulder and the upper arm by means of a shoulder harness. This can be quickly learned by the user.

The prosthesis that has been developed is called the Delft Cylinder Hand. It appears that the user is able to operate it easily: writing and using a pair of tweezers pose no problems, for example. Smit summarises the other advantages. 'The Delft Cylinder Hand is more than 50 per cent lighter than the lightest electric prosthesis, at less than 217 grams. The grip strength is greater than 30 newton. The user requires a lot less energy to operate the hand than is needed with the current range of body-powered hands, and the costs are also no higher than for electric

prostheses.'

'The Delft Cylinder Hand has been extensively tested at TU Delft with test subjects and prosthesis users. It is now ready to be tested beyond TU Delft in clinical trials. I expect that this prosthesis could be ready for use within five years.'

The dissertation is titled "Natural Grasping. Design and Evaluation of a Voluntary Closing Adaptive Hand Prosthesis."

Provided by Delft University of Technology