New microsurgery robot is five times as precise as a human hand

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One of the robotic arms and the accompanying joystick. Credit: Bart van Overbeeke.

A very steady hand and a lot of concentration: carrying out highly precise operations – for example to repair blood vessels or nerve fibers – places such high demands on surgeons that few are able to do it successfully. That means long waiting times for patients who need operations, for example after a serious accident or for the removal of a tumor. Mechanical engineer Raimondo Cau has developed a new robot specially for microsurgery. It enables surgeons to operate shaking-free with five times greater precision than by hand, so waiting lists can be

shortened. Cau will gain his PhD on 5 February at Eindhoven University of Technology (TU/e).

In reconstructive surgery, tissue removed from other places in the body is used to repair the form and function of the body. This is done for example in breast reconstruction, in children with congenital malformations or victims of serious accidents. The operations that are needed to attach blood vessels and nerve fibers to new tissue require such high precision that only a small number of surgeons can carry them out successfully. That means waiting times can easily be several months, and in some cases even more than a year.

Challenge

Prof. René van der Hulst, plastic surgeon at the Academic Hospital Maastricht (azM), asked TU/e to find a solution to this problem. Mechanical engineer Raimondo Cau took up the challenge, under the supervision of prof. Maarten Steinbuch. After observing numerous operations and holding discussions with microsurgeons, Cau built a working prototype that is five times as accurate as a human hand. "This is a tremendous step for microsurgery", says Van der Hulst. "Especially because we can see that there is an increasing need for highly precise reconstruction operations such as microsurgery and breast reconstruction."

Smaller movements

The robot has two joysticks operated by the surgeon. The movements of the joystick are 'scaled' to match the arms of the robot, which contain tools for the operation: a large deflection of the joystick is translated into a small movement of the robot arms. A foot pedal allows the surgeon to select the degree of scaling. The robot also filters out shaking of the

hands, and gives the robot arms an extra strong response to contact ('force feedback').

Making new operations possible

This robot will enable more surgeons to carry out highly precise microsurgery, and will allow waiting times to be shortened. The robot also reduces the physical burden on the surgeon. A third benefit is that the robot will make new and more precise operations possible, such as difficult reconstructions of the hand or face. The prototype will now be further developed together with azM, and the results of the first clinical tests are expected within the next year.

Provided by Eindhoven University of Technology