

# Researchers develop biomimetic hand prosthesis uniquely similar to a human hand

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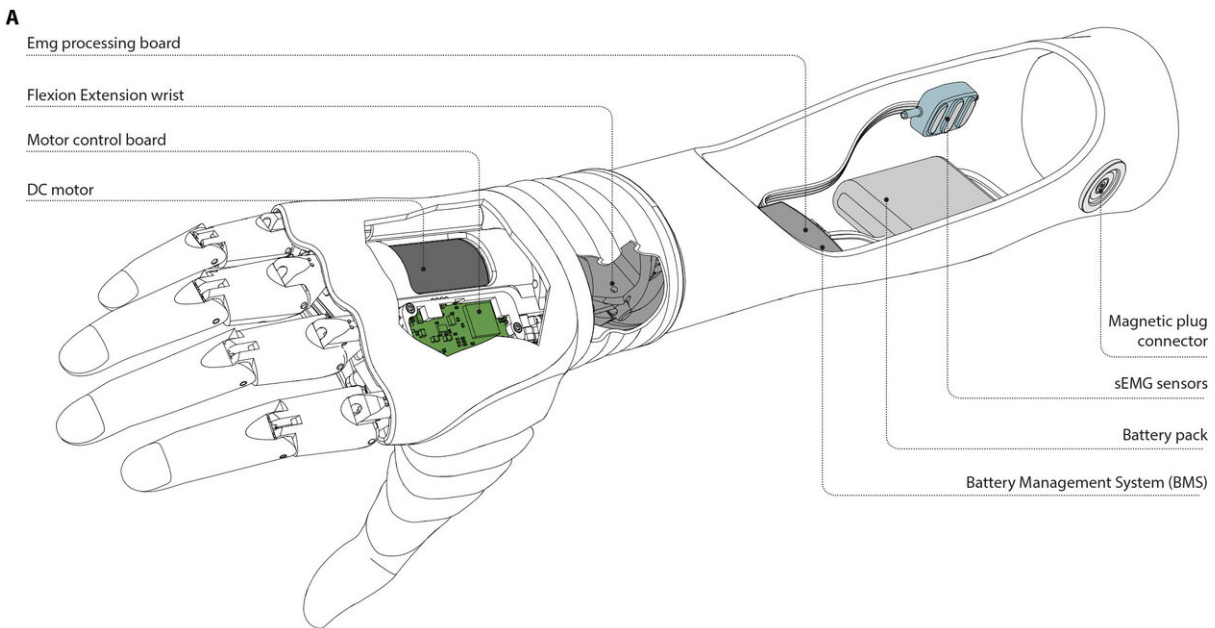
In the current issue of *Science Robotics*, researchers from Istituto Italiano di Tecnologia (IIT- Italian Institute of Technology) and Centro Protesi INAIL in Italy reported on their ability to replicate the key biological properties of the human hand: natural synergistic and adaptable movement, biomimetic levels of force and speed, high anthropomorphism and grasp robustness. Developed by a collaborative of researchers, orthopaedists, industrial designers and patients, the prosthetic hand called Hannes is able to restore over 90% of functionality to people with upper-limb amputations.

Hannes is an anthropomorphic, poly-articulated upper limb prosthetic system including [hand](#) and wrist, whose main characteristics are softness and the ability to dynamically adapt to the shape of objects to grasp. It is uniquely similar to a human hand, and being developed directly with patients, has immediate practical use. To evaluate the effectiveness and usability of Hannes, pilot trials on amputees were performed at Centro Protesi Inail, and the researchers found that after a training period of less than one week, patients could autonomously use Hannes to perform activities of daily living.

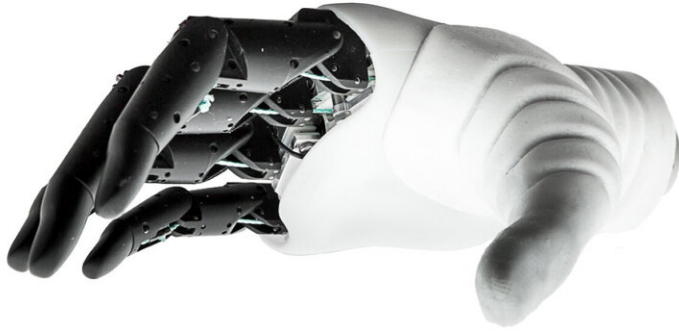
The prosthesis is a myoelectric system that can be worn all day, and is adjustable to a variety of upper limb impairments. An array of surface electromyographic sensors placed within a custom socket detects the activity of the residual limb muscles in the lower or higher part of the arm, which are actively contracted by the user to perform multiple movements. Moreover, through specially developed software and a Bluetooth connection, it is possible to customize the operating parameters of the hand, such as the precision and speed of movements, to ensure the most optimized experience for each user.

Hannes hand has been tested for durability and robustness in a setting that simulated more than one year of use by a so-called "pro-user," lasting almost 500,000 life cycles.

The true intelligence of Hannes lies in the [mechanical design](#), which is completely unique in its market sector, and it gives the prosthesis the versatility and the movement of a natural hand. The underlying mechanism of the hand is a mechanical differential system that allows Hannes to adapt to the object being grasped by using just a single motor. This also dramatically enhances performance due to its efficiency. It also corresponds with the 50th percentile of human hand size. Hannes is provided in two sizes, 7 <sup>3</sup>/<sub>4</sub> and 8 <sup>1</sup>/<sub>4</sub>, for right and left hand replacement, and is suitable for female and male subjects. Its weight is 450 grams.



The architecture of the Hannes prosthetic hand. Credit: Laffranchi et al., Sci. Robot. 5, eabb0467 (2020)



The Hannes prosthetic hand. Credit: Laffranchi et al., *Sci. Robot.* 5, eabb0467 (2020)



Gloved Hannes device performing a precision grasp of a pen, a lateral grasp of a business card, a power grasp of a compliant object (spray bottle handle), lateral grasp of a marker, and a power grasp of a tool. Credit: Laffranchi et al., *Sci. Robot.* 5, eabb0467 (2020)

Fingers can flex and be positioned in a natural manner, even at rest. In particular, the thumb can be oriented in three positions to replicate a wide variety of grips, including a fine grip for picking up small objects, a lateral grip to grasp thin objects, and a power grip capable of grasping and moving even heavy loads. The overall grasp is efficient, robust against external conditions and natural. The system also permits the pronation and supination of the wrist ("key turning movement"), allowing grasps in different orientations without relying on harmful patient compensation.

Hannes can perform a full closed grasp in less than one second, and can exert a maximum grasp force of 150N, which is well beyond other commercial and research poly-articulated hands. It has an autonomy of a whole day of standard use (battery life of one day: 12V power supply for a battery capacity of 1300 mAh).

The researchers conducted experiments to validate Hannes's performance and the human-likeness of its grasping behavior and demonstrated improved performance compared with existing research and other commercial devices.

**More information:** M. Laffranchi et al., The Hannes hand prosthesis replicates the key biological properties of the human hand, *Science Robotics* (2020). [DOI: 10.1126/scirobotics.abb0467](https://doi.org/10.1126/scirobotics.abb0467)

A more human prosthetic hand, *Science Robotics* (2020). [robotics.sciencemag.org/lookup ... /scirobotics.abd9341](https://robotics.sciencemag.org/lookup/.../scirobotics.abd9341)

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