

An innovative multisensor controlled prosthetic hand

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Prosthetic hands

- absence of products with reduced hand size and weight
- only one practical degree of freedom (DOF) of actuation
- only EMG signals used

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The *Tiny-Hand* concept

1 – Small dimensions

- prosthetic device designed for women and adolescents patients, with independent finger movements

2- Innovative control strategy of multisensor platform to encode patient intention

- data fusion of EMG, FMG and inertial sensors

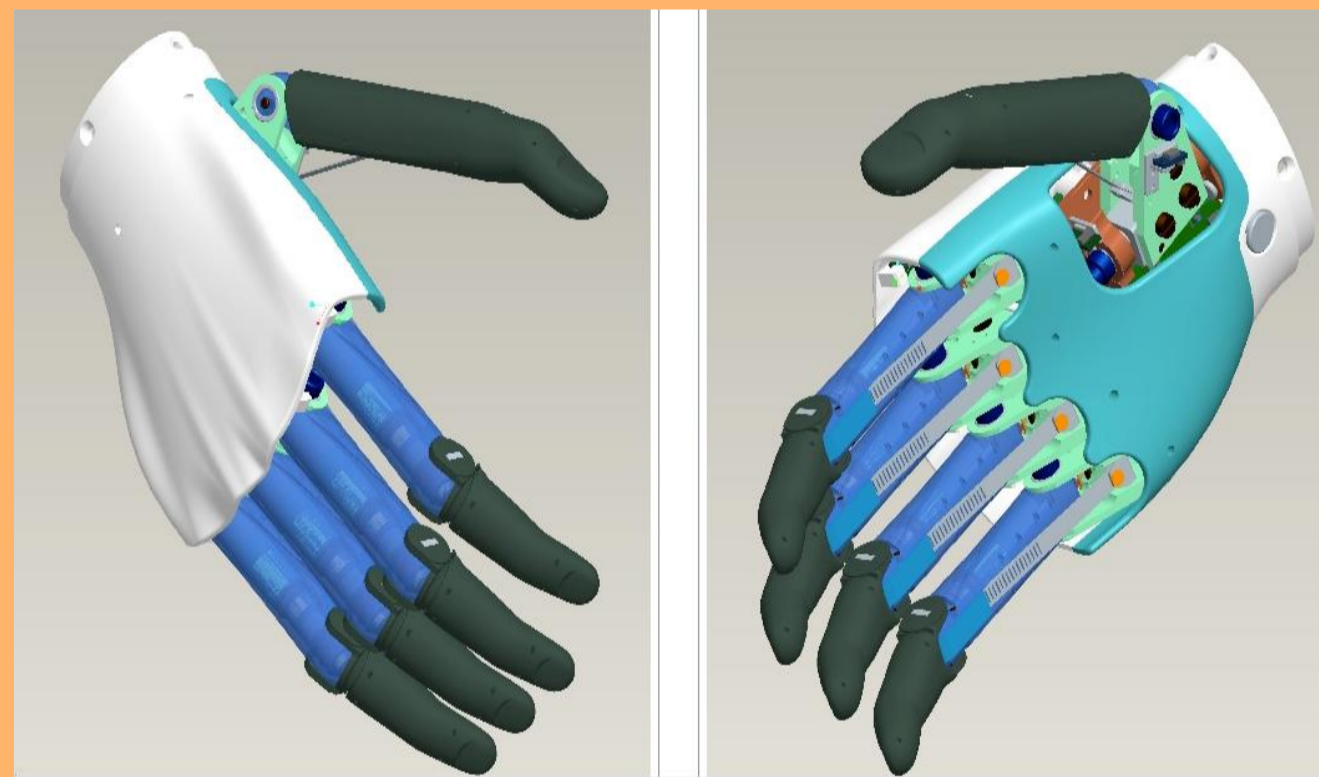
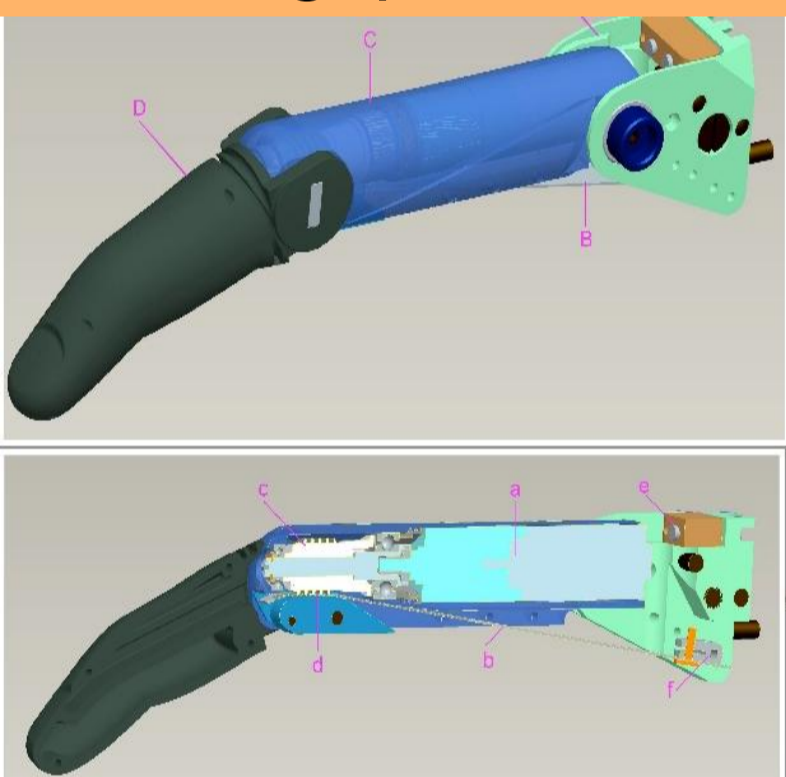
3 - Designed also for partial hand amputation

- important advantages relative to cost production

Mechanical Design

Tiny-Hand is a prosthetic device designed for women and adolescents patients

- Penta-digital prosthetic device with passive thumb's abduction-adduction
- very good bio-mimetic reproduction
- DC motor located on the finger, useful also for partial amputation
- High stiffness in extension movement – suitable for power and precision grips



Sensing systems & strategy

Multisensors concept

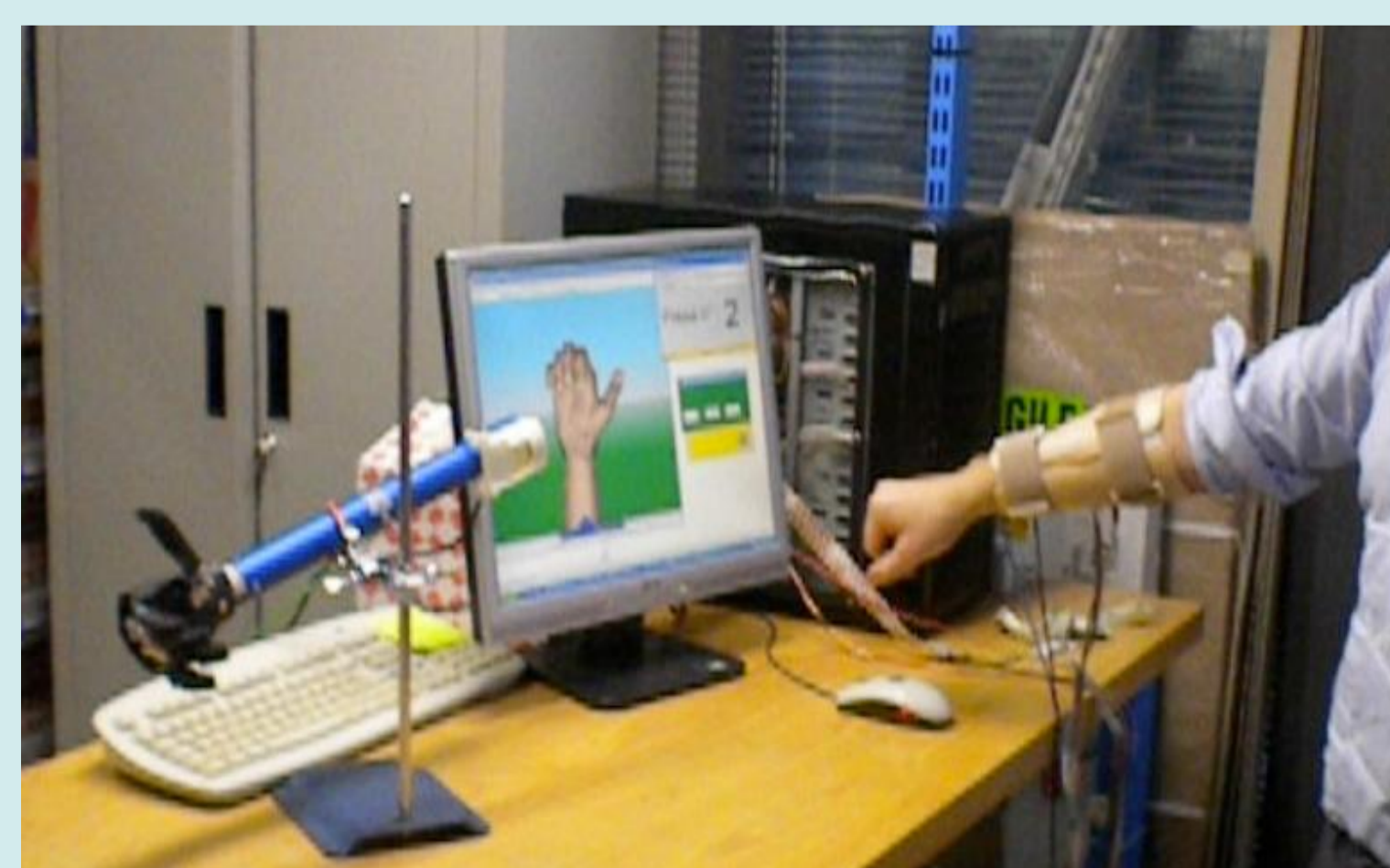
- standard EMG electrode
- In socket pressure sensing through force sensitive resistors (FSRs) for Force Myography (FMG)
 - FMG** measures the pressure on the forearm caused by the muscular activity.
 - reduced sensor cost and complexity
 - redundant configurations to reduce personalization efforts
- Inertial sensor** (ADXL330 by Analog Devices) to perform different kind of hand grips/positions



Tests and Results

Control strategy

- FMG (carpal flexors) -> **hand activation**
- EMG (carpal extensors) -> **hand deactivation**
- Inertial (forearm) -> **grip selection** based on forearm inclination



Sensing system linked to a tridimensional hand model replicating the prosthetic hand functionalities

- Testing the performance on normal subjects
- Above 90% of the hand grips were effectively recognised

Signals acquired on a patient performing continuous cycles of alternate activations of the carpal flexors and extensors.

- close correlation between FMG and EMG in the flexor area
- low correlation of the FMG and EMG taken on extensor one.

