Design and Development of a Mechatronic Transradial Prosthesis

J.Fasoulas[*], M. Sfakiotakis[+], M. Petousis[*],
S. Kalantzis[*] and G. Kampourakis[*]
[*]Dept. of Mechanical Engineering,
[+]Dept. of Electrical Engineering,
Technological Educational Institute (T.E.I.) of Crete
Heraklion, Greece

Control Systems and Robotics Laboratory

Technological Educational Institute of Crete

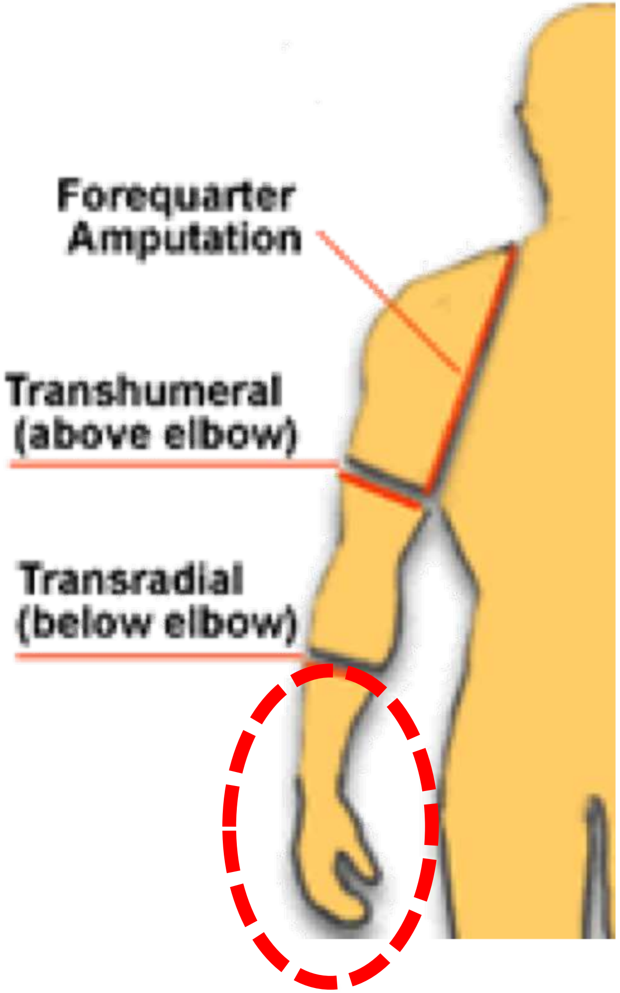
Outline of the presentation

- Explain what is a Transradial Prosthesis
- Classification of Transradial Prosthesis
- Present the designed transradial prosthesis
- Early experiments
- Future Work

Transradial level of ambutation





The most common causes of upper limb amputation in are:

- Accidents
- Infection or burns
- Disease
- Conditions present at birth

The loss of a limb is one of the most **psychologically**, **physically** and **financially** devastating events that can happen to a person.

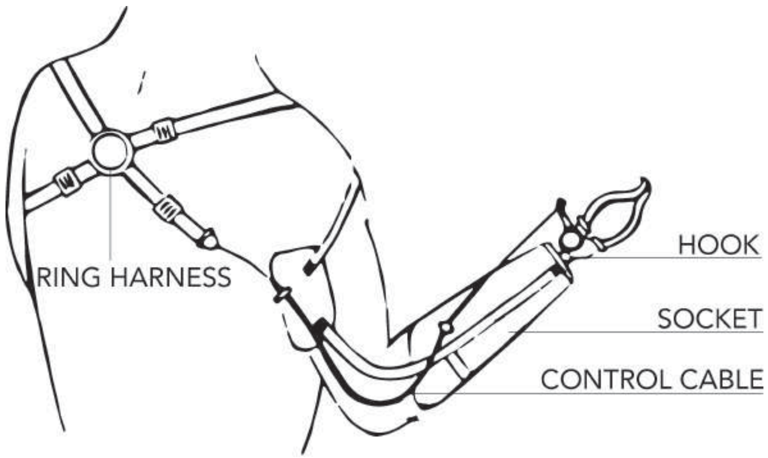
- The **quality of life** is reduced.
- In many cases the living and the working environment must be modified.
- In many times they depend on **other people's** help.

Classification of the Transradial prosthesis

Transradial Prosthesis can be classified into the following main categories:

(a) The Cosmetic Prosthesis

(b) The Body Powered or Cable Operated Limbs



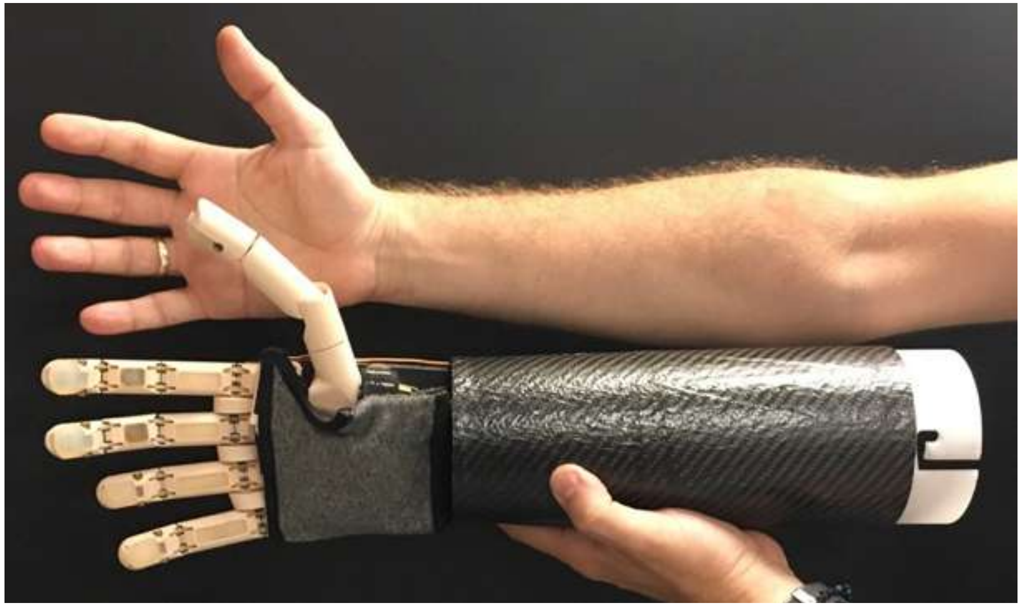
michelangelo

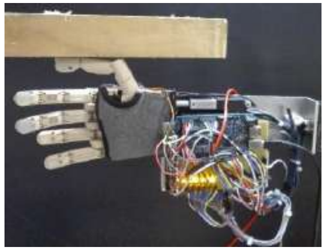
i-Ilimb ultra

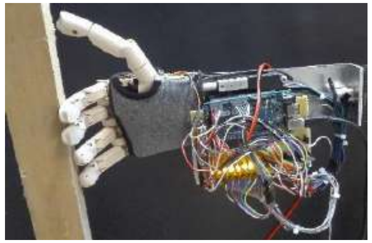
bebionic

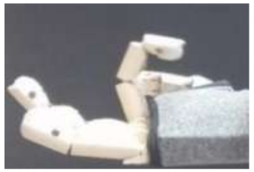
(c) The Myoelectric Prosthesis

The Designed Transradial Prosthesis







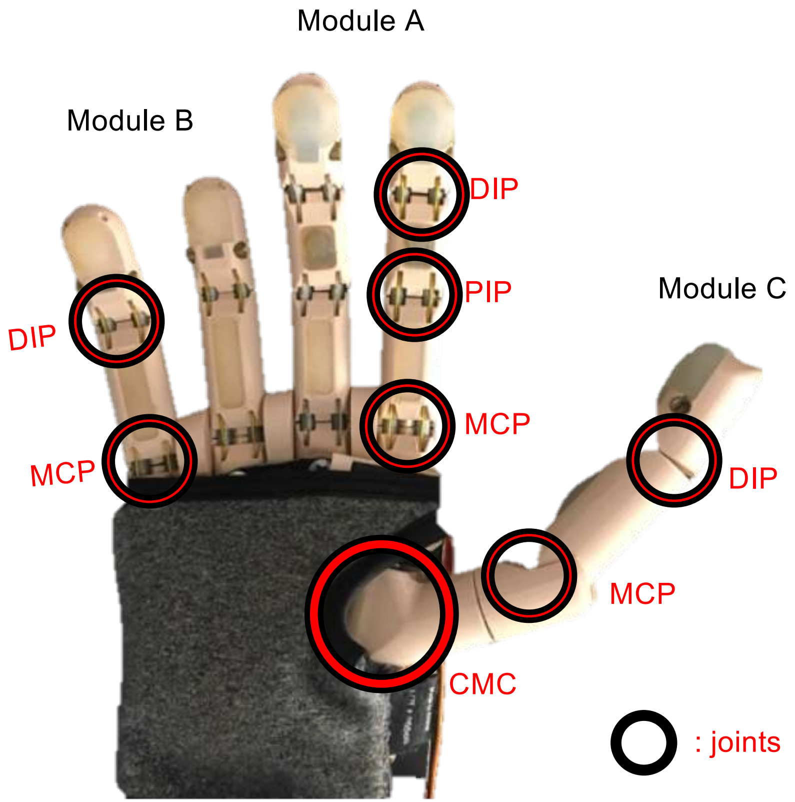


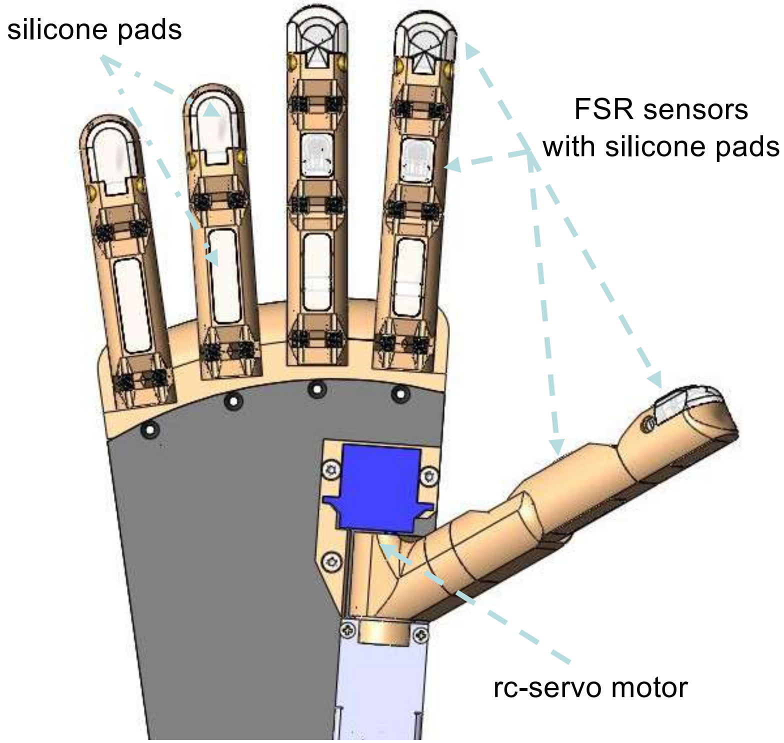
- 5 digits
- 13 joints
- 6 actuators
- 6 Force Sensing Resistors (FSR)
- **1041gr = 503gr +538gr**
- Compliant behavior
- Open - Close the hand in 2 sec
- Each fingertip can exert forces up to 2N
- The hand can hold firmly objects up to 5 kg

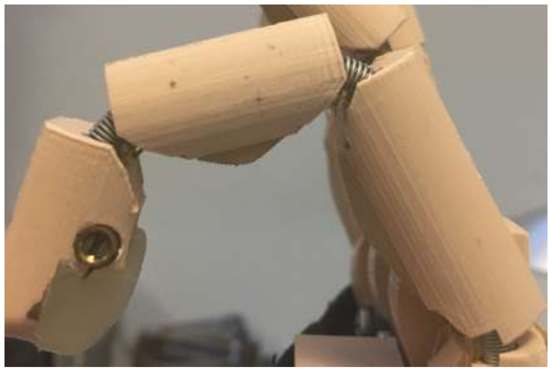
Mid-size Human forearm 1400gr
Mid-size Humanhand 500gr
In total about 2Kg

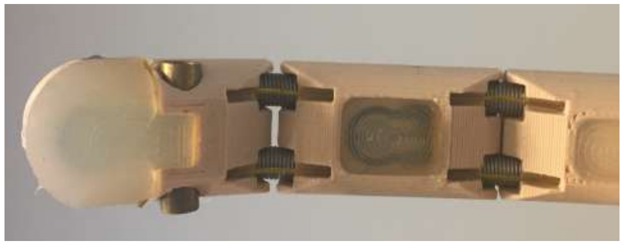
General Description of the Hand

Three modules
13 d.o.f.
6 actuators





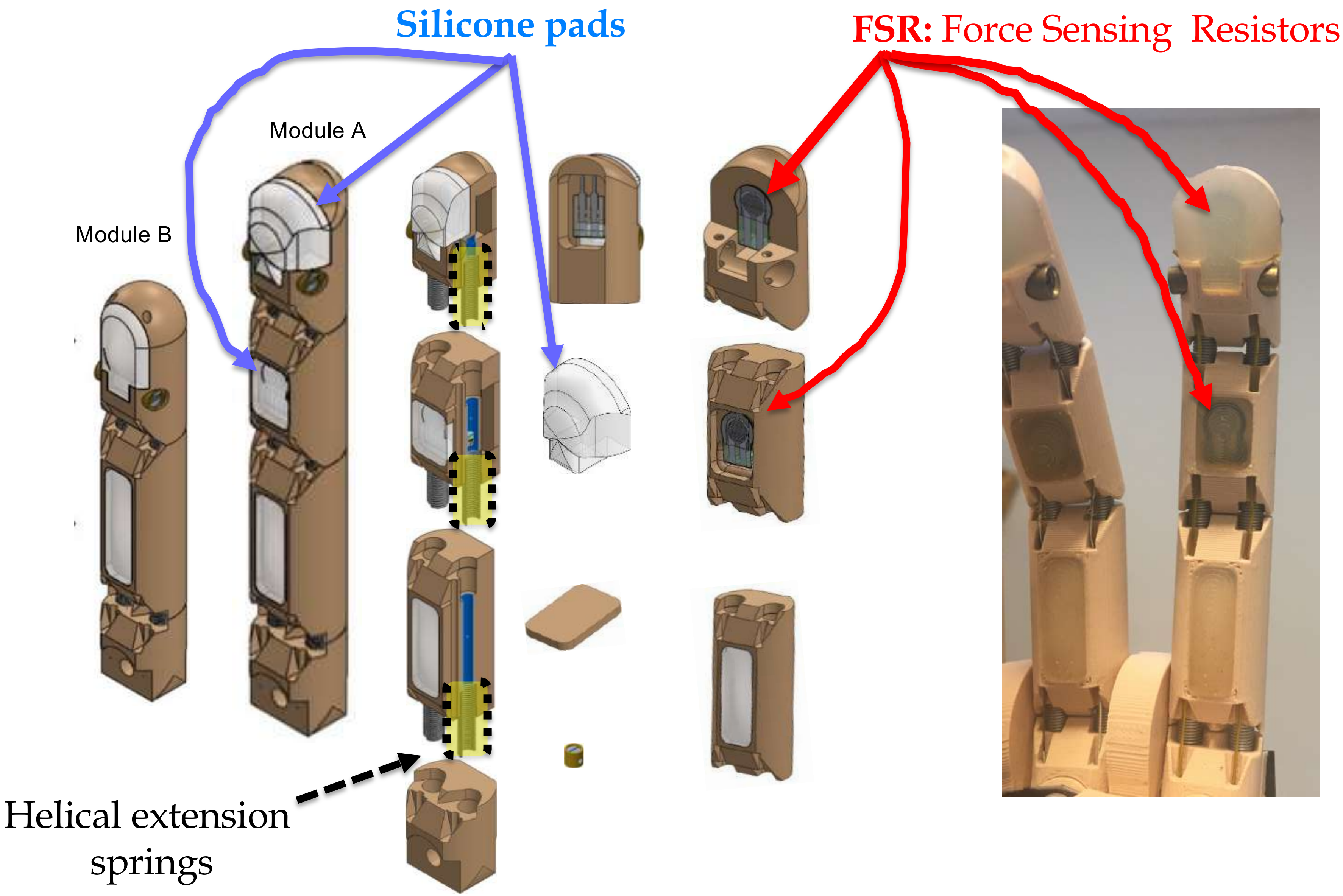




- ❑ Pulling tendons: are firmly connected to the distal phalanges near the fingertip

- ❑ Joints: Helical extension springs

The fingers with the silicone pads and the FSR sensors

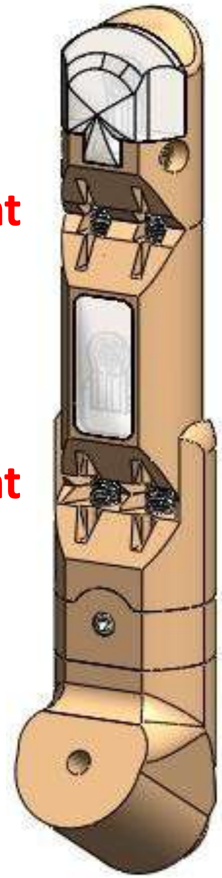


The opposable thumb

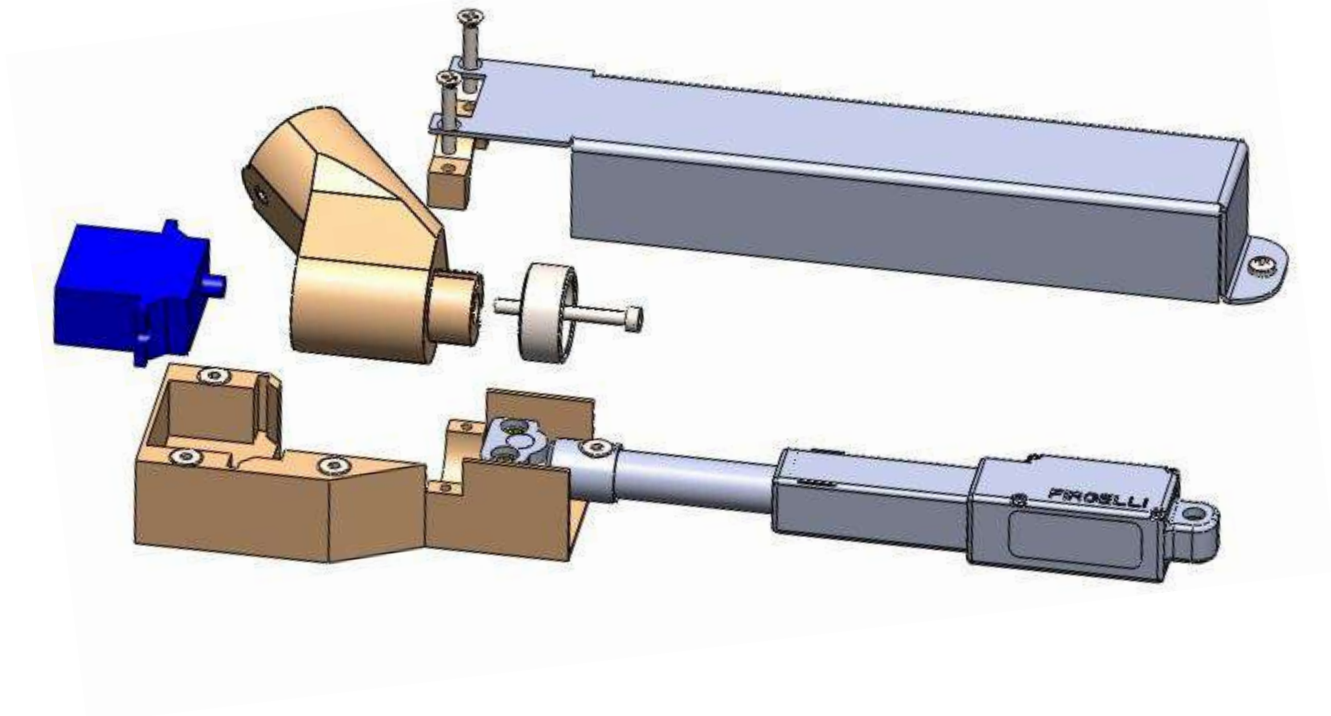
DIP - joint

MCP - joint

CMC - joint

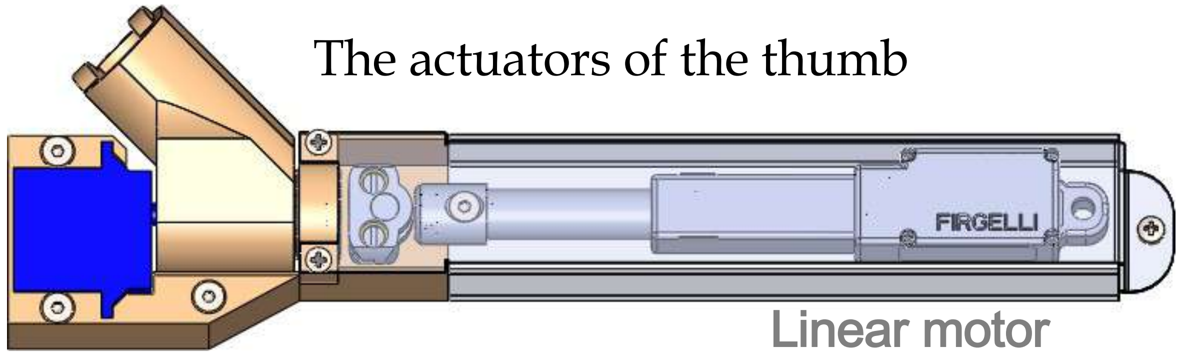


Exploited view of the CMC joint of the thumb



RC- servo motor

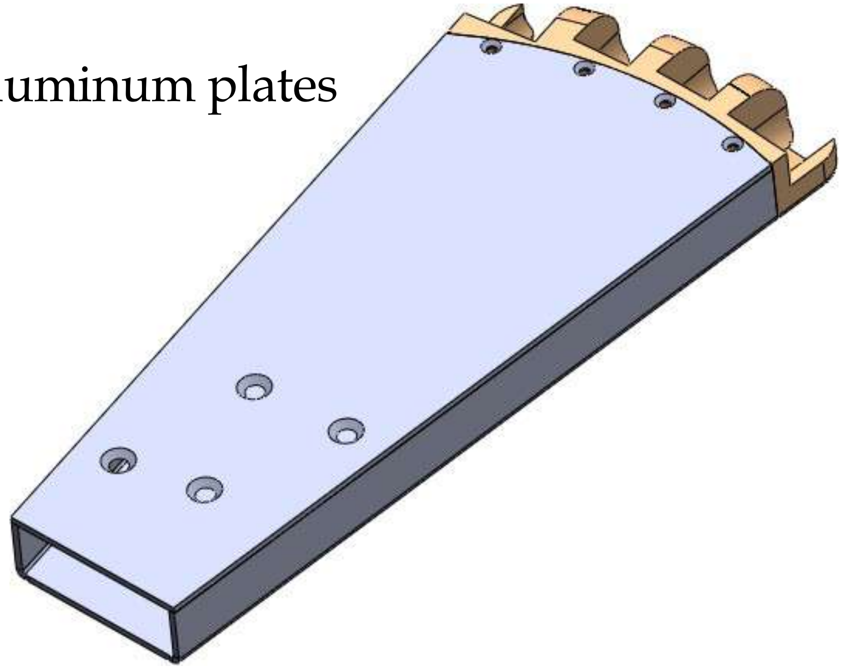
The actuators of the thumb



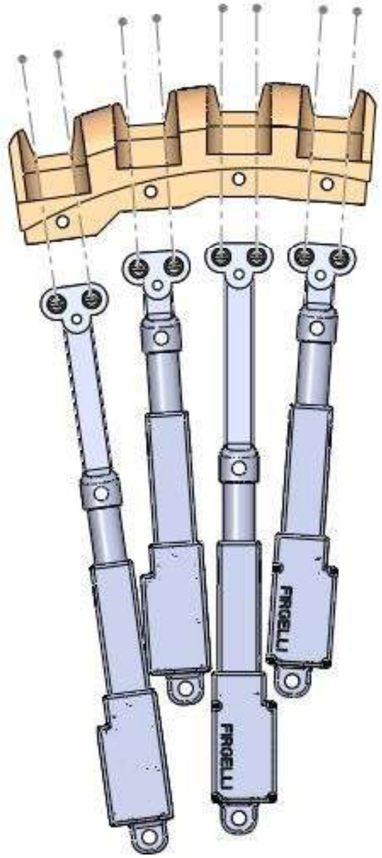
Linear motor

The palm of the hand

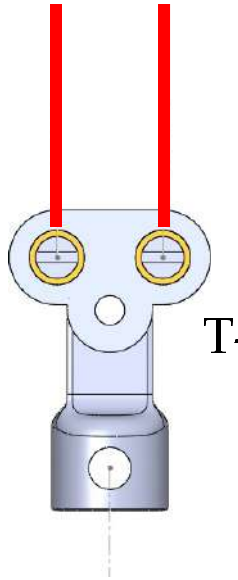
Aluminum plates

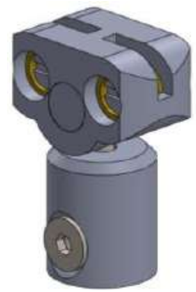


Base of the fingers



tendons

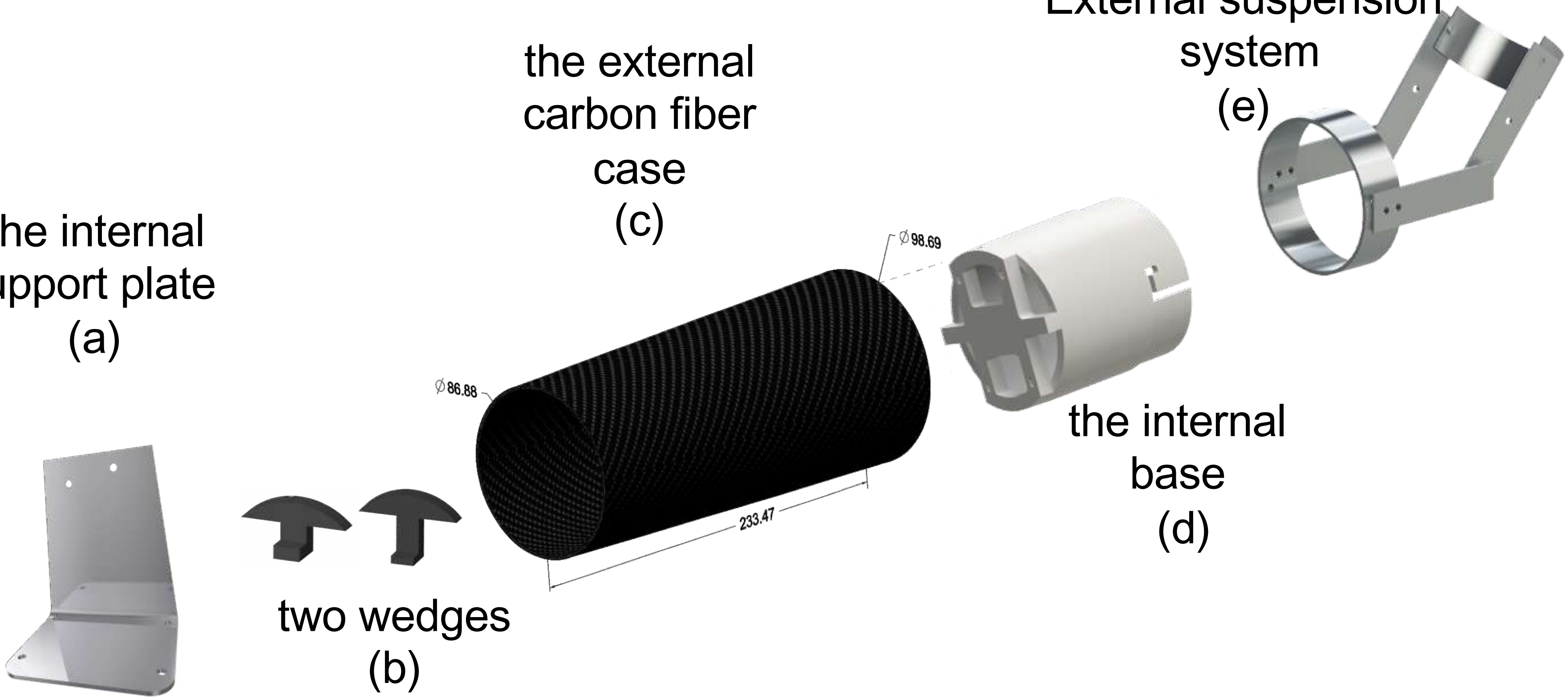




T-shaped link

Micro Linear servomotors

The fore-arm design



The internal support plate (a)

two wedges (b)

the external carbon fiber case (c)

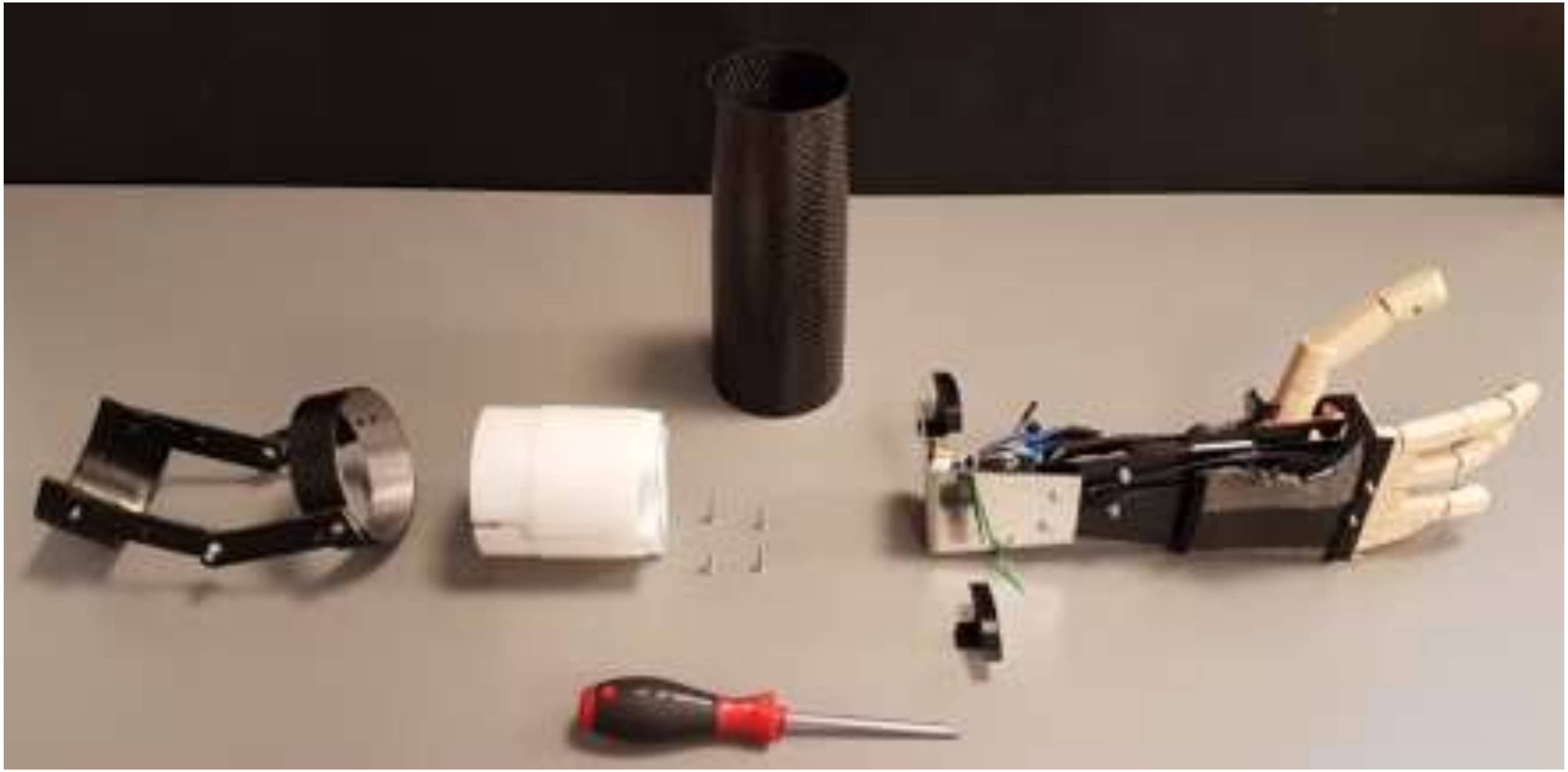
the internal base (d)

External suspension system (e)

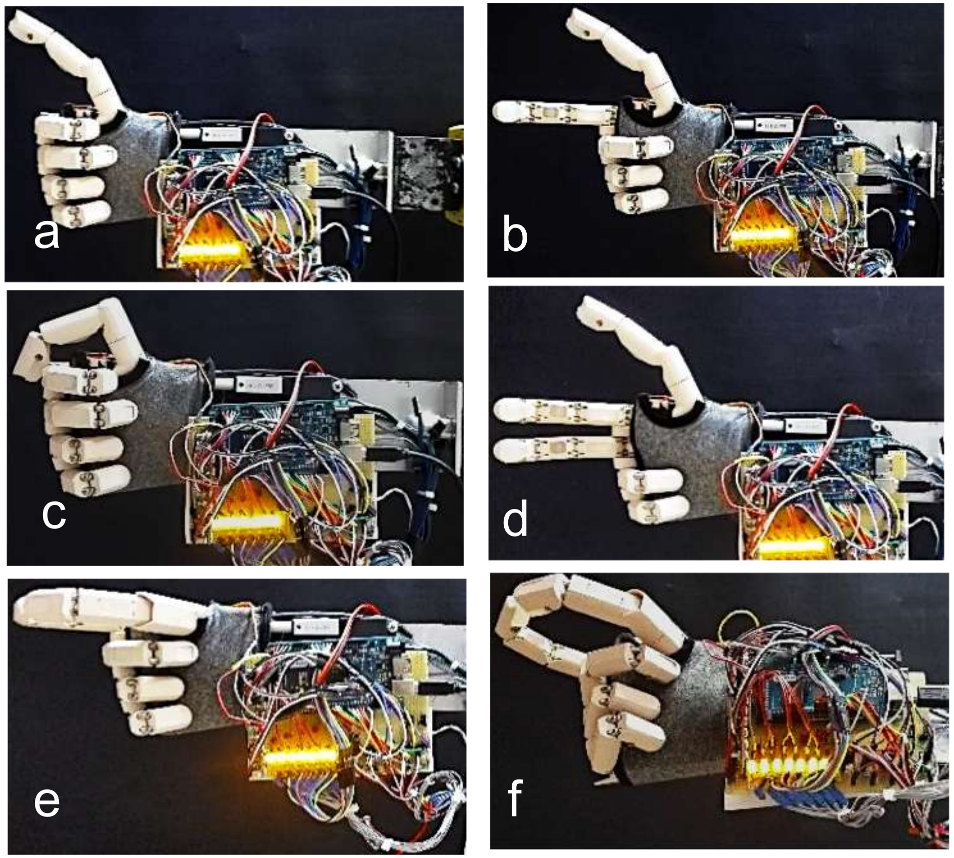
(a)	(b)	(c)	(d)
200gr stainless steel	13gr PLA	95gr Carbon Fiber Reinforced Polymer	230gr (Ertacetal)

Total = 538gr

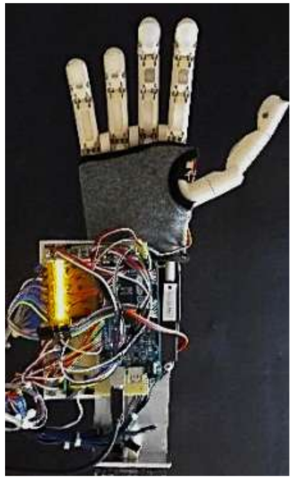
The manufactured parts of the forearm

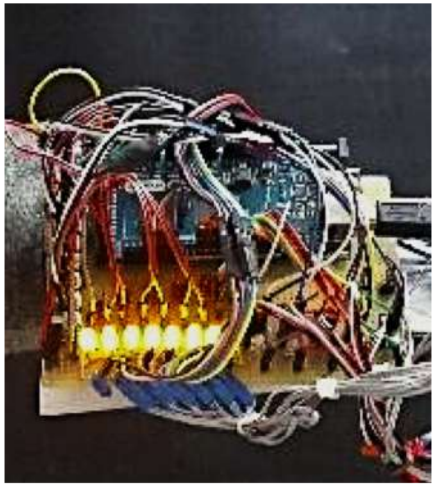


Experimental results for hand gestures



- Experiments for gesture patterns and stable grasps
- An electronic prototype board was designed in order to interface the FSR sensors and the actuators with an Arduino Mega microcontroller.

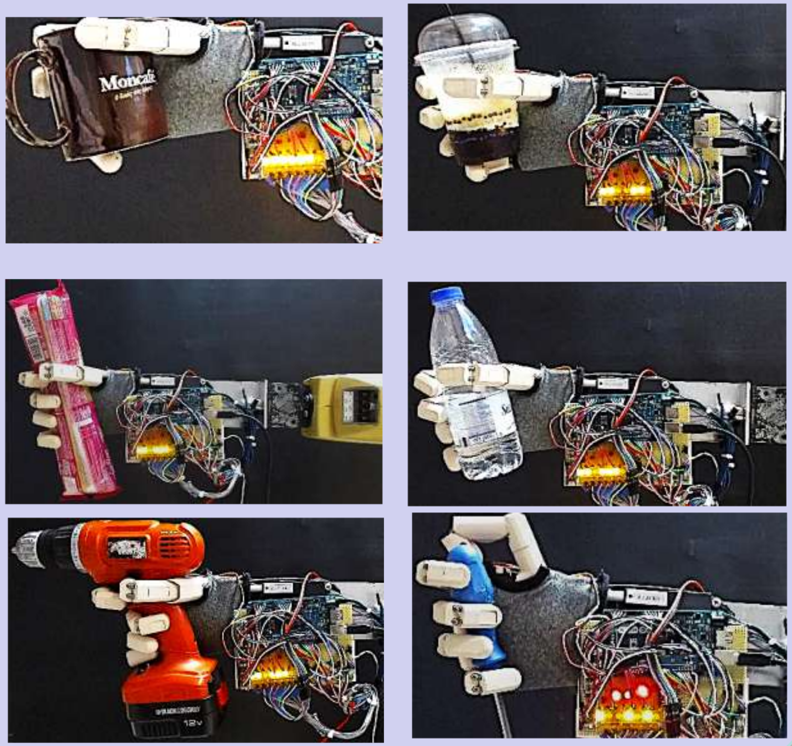




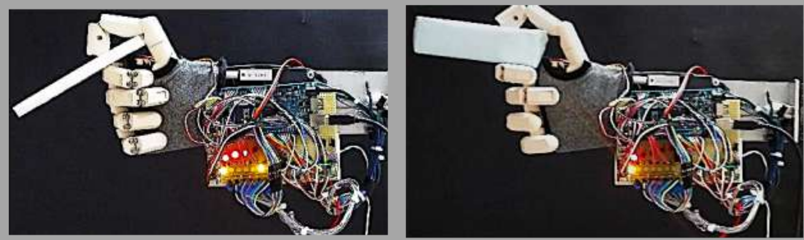
Experimental results for grasping objects

- Experiments: everyday objects with different shape, size and weight from 50gr to 1200gr

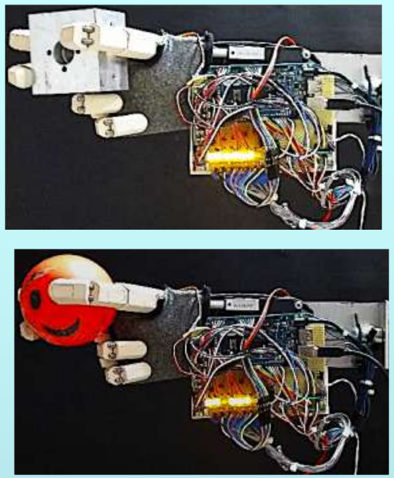
Power Grasp



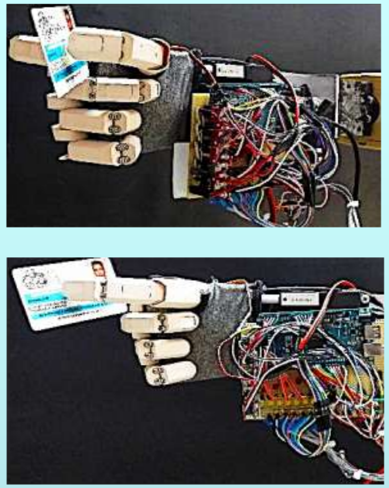
Lateral prehension



Three-finger grip

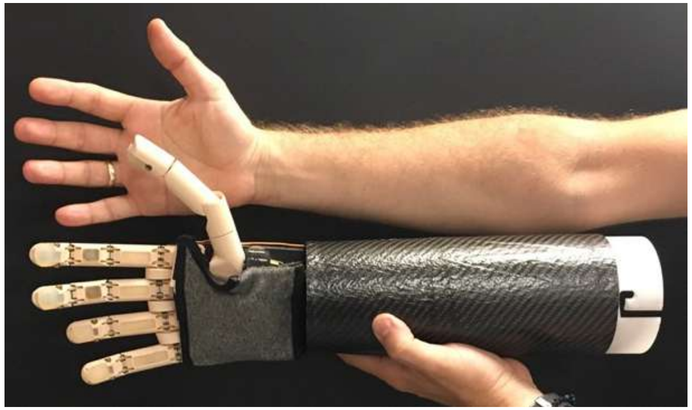


Precision grip



Conclusion and future work

- We became familiar with the design and development of a mechatronic transradial prosthesis and presented experimental results
- Future work will address the **integration** of electronics and the batteries into the forearm case along with **EMG** to the remaining limb
- Improvement of the **control algorithm** and **test** the prosthesis on an amputee.



Electromyographic Sensors (EMG)

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Thank you !