



ASSOLOMBARDA
Confindustria Milano Monza e Brianza

Assistive exoskeleton for patients with neuromuscular diseases

objectives and state of progress

Speaker

Prof. Francesco Braghin

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OVERVIEW OF THE PROJECT

Goal of the project

- Design a **modular arm support** for patients with neuromuscular diseases which can be mounted on a wheelchair:
- it should be adaptable to the patients arm in an easy way;
- it has to be lightweight including a weight compensation mechanism for the patients arm weight.
- Mechanisms for control flexible and customizable (i.e: voice control, manual control and control through vision systems)

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ARM DESIGN

arm support motions allowed:

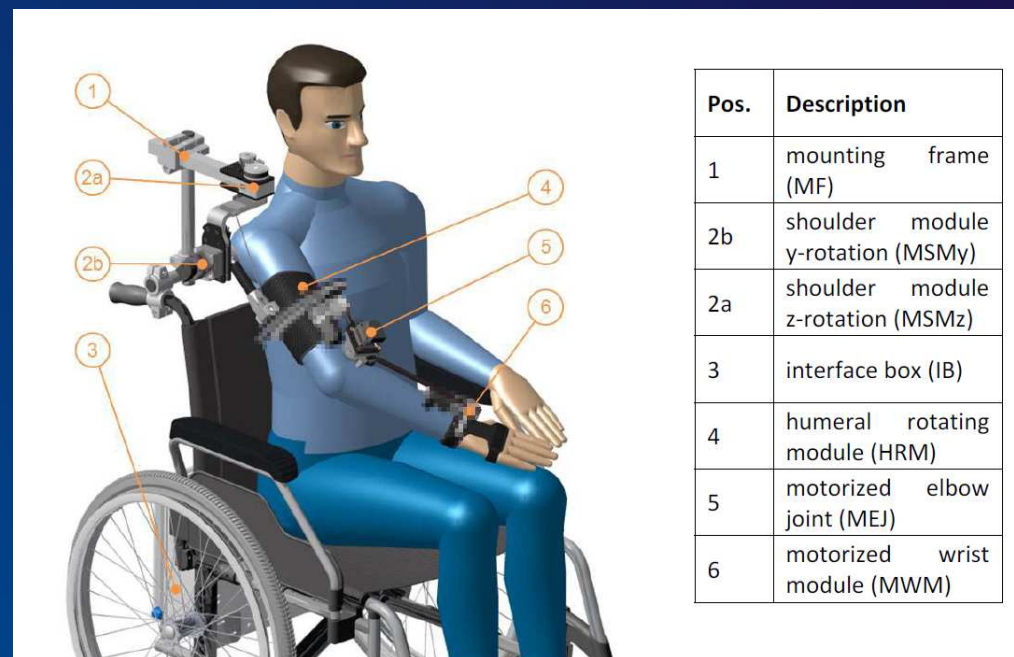
- Wrist pro-/supination (up to ± 45 degrees)
- Elbow flexion/extension,
- Upper arm medial/lateral Rotation
- Shoulder flexion/extension
- Shoulder rotation (maximum humeral rotation of 90 degrees)

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The 5-DoF exoskeleton mounted on a wheelchair is shown.



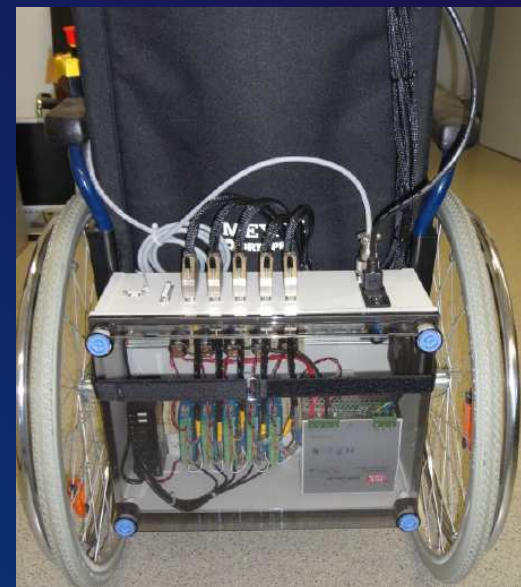
five basic modules connected with carbon rods or carbon tubes and fixated with clamping mechanisms

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- the complete prototype of the exoskeleton has a maximum mass of about 6 kg, the moving parts 3-4 kg
- All stepping motors are armed with angle encoders
- All controllers communicate via USB and can be actuated by a computer
- The electric equipment works on 48V DC that will be provided by a power supply



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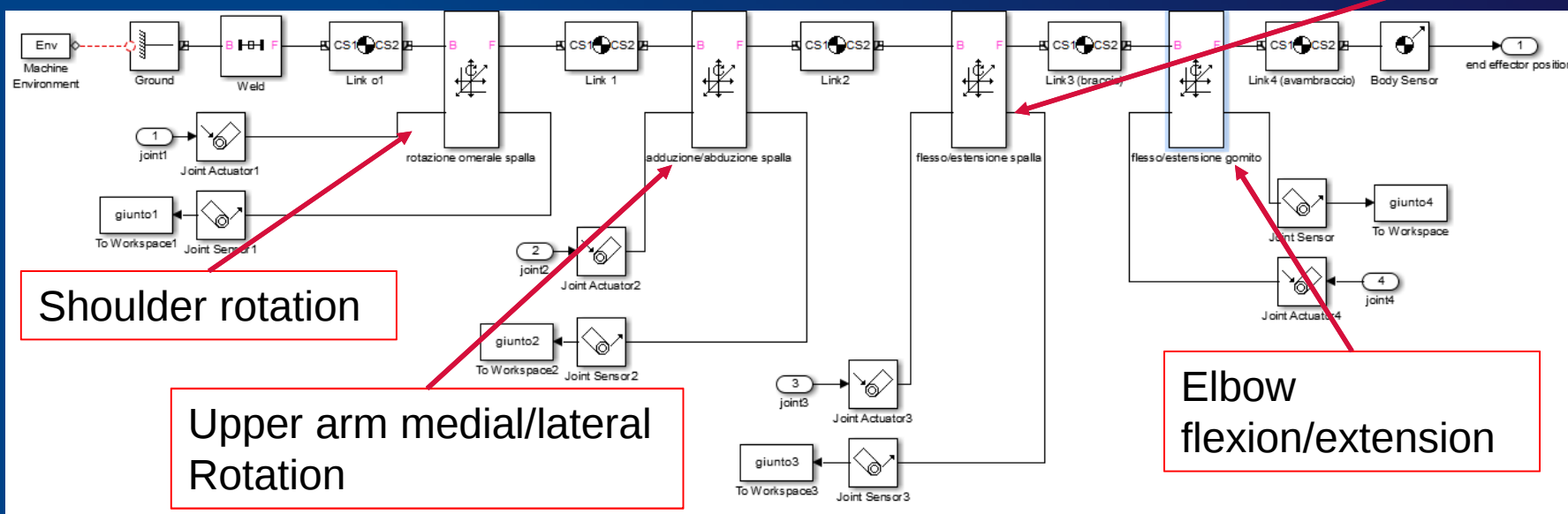


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ARM DYNAMIC\ KINEMATIC MODEL FOR CONTROL

arm was numerically modelled using SimMechanics™ :

Shoulder
flexion/extension



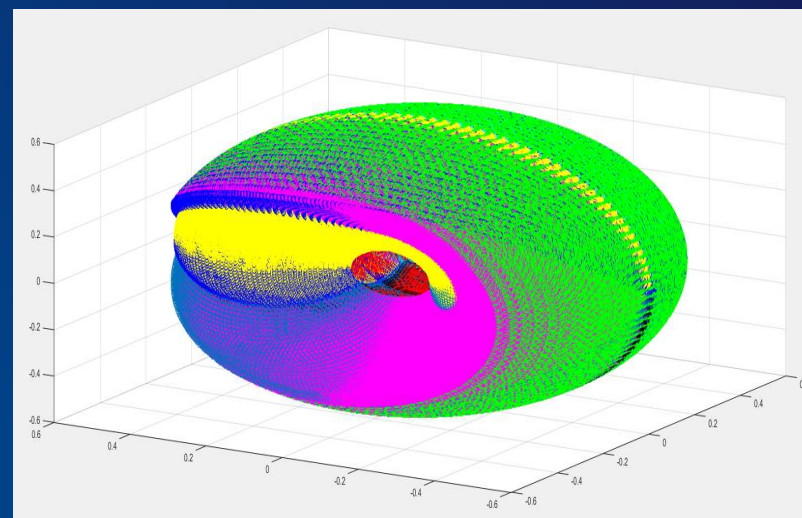
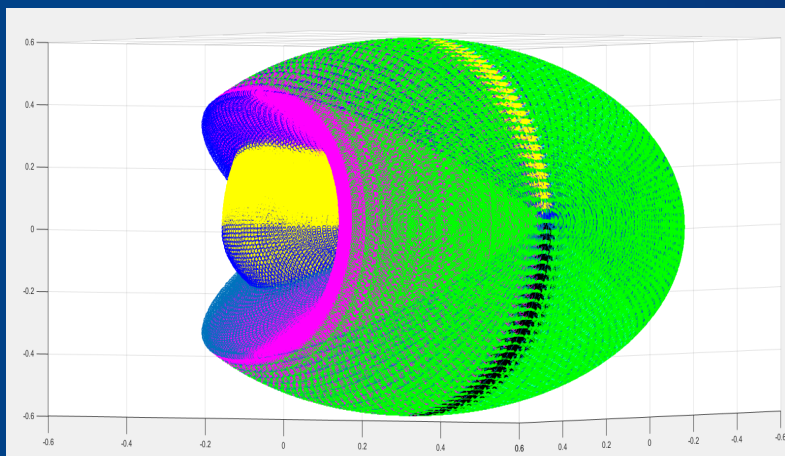
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ARM WORKSPACE ANALYSIS

reconstruction of the maximum reachable working area



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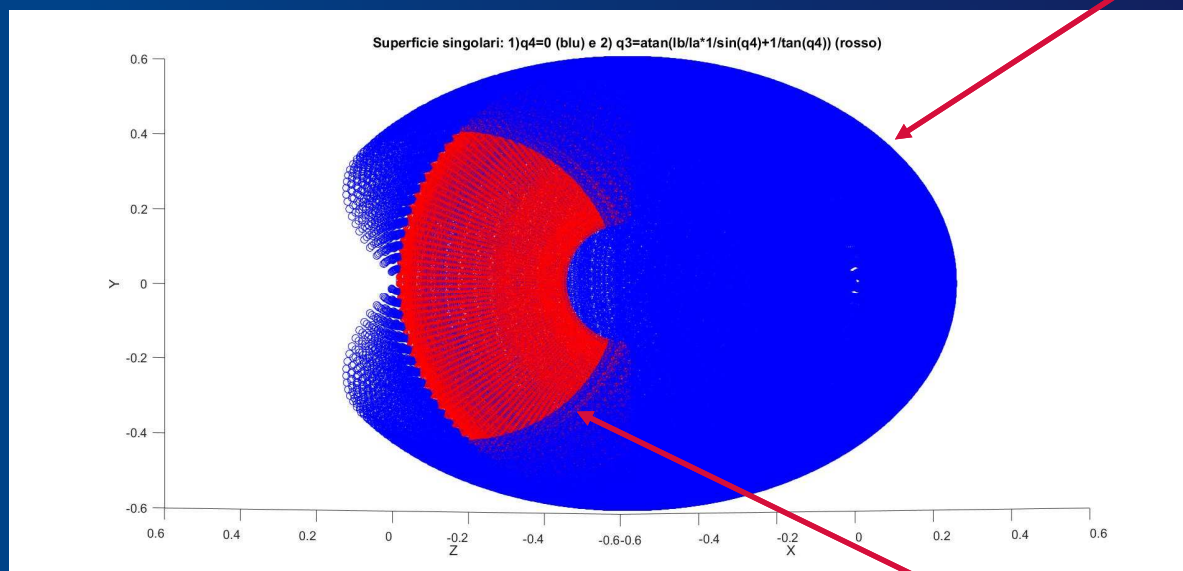


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ARM WORKSPACE ANALYSIS

Singularity surfaces analysis

Singularity surface
(elbow completely extended)



Singularity surface
(elbow – shoulder
combination)

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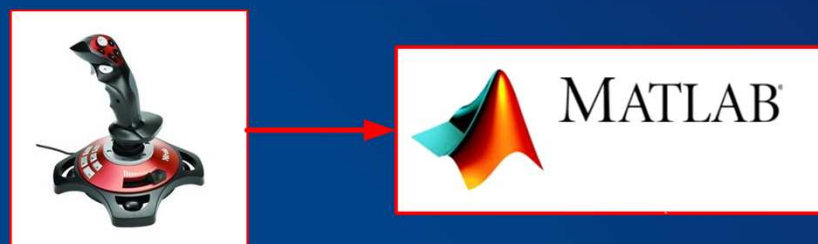


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ACTUALLY UNDER DEVELOPMENT

Manual control mode:

- Joystick interface
- Target point achievement
(check of belonging in the workspace; computation of joint configuration that minimize torque required and avoid singularity)



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ACTUALLY UNDER DEVELOPMENT

Automatic control mode:

- Previously saved target-point
- Target point achievement
(3D discretized workspace, sensing obstacle presence, computation of optimal trajectory with obstacle avoidance)

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