Applications

- Robot-assisted rehabilitation and physical therapy
- Assistance for dependent people
- On-body robotics and detachable end-effectors
- Safe handling of people in rescue and care scenarios

Let's work together

We are looking for clinical and industrial partners to bring these technologies into real settings: validation with patients, integration into rehabilitation and assistive products, and joint development of new end-effectors.

Team and affiliation

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MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES
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This project is part of project PID2021-127221OB-I00,
funded by MICIU/AEI/10.13039/501100011033/FEDER, UE

CONCERTO

UNIVERSIDAD DE MÁLAGA
IMECH.UMA

Safe human-arm grasping with end-effector robots

Markerless multimodal perception and control that respects the person's joint limits

Collaborative control for empathic physical human-robot interaction

Demonstrator: collaborative manipulator, instrumented gripper and multi-camera system.

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The challenge

An ageing population and an overstretched healthcare system call for systems that can physically assist people. Almost all collaborative robotics is designed to avoid contact with humans. CONCERTO tackles the opposite problem: letting the robot grasp and move a person's limb safely and adaptively.

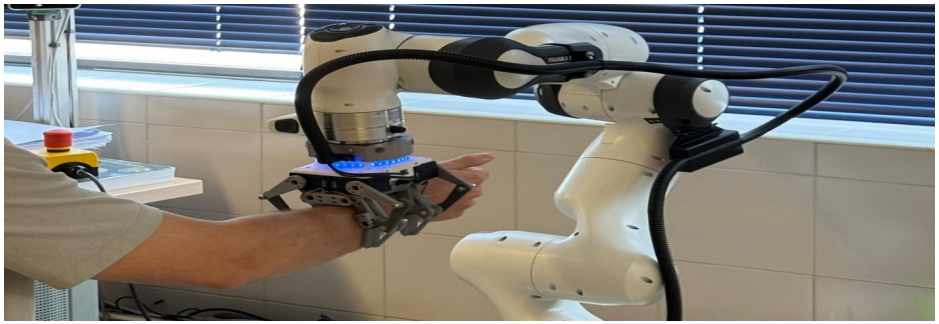
What we have developed

Proprioceptive underactuated grippers. They estimate interaction forces and grasp geometry from their own structure, with no dedicated force sensors.

Markerless perception robust to occlusion. Multi-camera vision fused with proprioceptive data from the gripper reconstructs arm posture even when the robot blocks the view.

Empathic shared control. It weighs human and robot contributions by performance and respects the person's joint limits and the manipulator's singularities.

Detachable specialised grippers. They detach from the manipulator, stay attached to the limb and travel along it to reposition the grasp, with proprioceptive limb-diameter estimation.



Instrumented underactuated gripper grasping a person's forearm.

Results

The project has met its overall goal: robots able to autonomously manipulate a person's limbs for assistance and rehabilitation. The specialised grippers grasp the limb without placing markers or wearables on the patient; the system determines the limb's joint posture during the grasp itself; and the empathic control keeps motion within the person's safe joint ranges while placing the manipulator in configurations that maximise its working capability.

2.6 cm

median wrist error during grasping, against 13 cm for vision-only methods (80% lower)

< 5.4°

median joint-angle error across all joints, within the range of manual goniometry (6.2°-11.7°)

20

volunteers in the validation against the OptiTrack motion capture system

TRL 5

transportable demonstrator running in real time at 30 Hz

In addition

- 8 scientific articles and 10 contributions to international and national conferences.
- Mechanical designs, firmware, software and datasets released openly under CC BY licences with DOI.
- One PhD thesis defended and three in progress.
- Collaboration with hospital clinical services and with international groups (University College London) and sector companies (Shadow Robot Ltd.).

System validation: instrumented dummy, multi-camera calibration and EMG trials.