

PERSONAL INFORMATION

Francesca Cini

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WORK EXPERIENCE

December 2018 - Now

**Project work in Advanced Laboratory Automation,
The BioRobotics Institute of Scuola Superiore Sant'Anna (Pisa, Italy)****Main activity**

Development of innovative, autonomous, and robotic solutions for clinical processes in line with the principles of Laboratory Automation and industry 4.0.

My main activities in the project are:

- Design and development of a software (C# language and JavaScript language) that allows a remote PC to control different devices using TCP/IP communication protocol. The software receives the messages from the remote PC and sends them to the correct device using the appropriate communication protocol (and vice versa). In order to manage the devices, the software exploits serial communication protocol, CAN communication protocol as well as TCP/IP connection.
- Data analysis using Matlab (MathWorks, Inc.) and MySql (Oracle, corp.) database.
- Design of experimental protocols for testing and validation of devices' performances.

June 2020 - August 2020

Technical consultancy and collaboration**Main activity**

Development of a collaborative robotic system for biomedical industrial application.

My main activities in the project were:

- Design and development of a software with a GUI (C# language) that allows a PC to communicate and control a collaborative UR3 robotic arm (Universal Robot). In particular, the software receives the user's input through the GUI and sends the appropriate messages to the robot using a TCP/IP communication protocol. The software running on the robot, that I developed and implemented using URScript Programming Language (Universal Robot), interprets the messages sent by the PC and accordingly controls the motion and behaviour of the robot.
- Installation of the developed collaborative system in the final industrial setting and acceptance test.

December 2019 – July 2020

**Occasional employment at The BioRobotics Institute of Scuola Superiore
Sant'Anna (Pisa, Italy)****Main activity**

Technical feasibility study and definition of technical specifications and requirements for the development of a collaborative robot system able to move flexible and rigid objects for food industry applications.

My main activities in the project were:

- Analysis of the industrial process phases in which the robotic system had to work in collaboration with human operators.
- Definition of both mandatory and optional requirements and technical specifications that a

collaborative robot system had to comply with, in order to be employed in the industrial applications under examination.

- Draft of two possible layout solutions of collaborative robot systems that could be integrated into the examined industrial process phases.

November 2018 and
November 2019

Collaboration with The BioRobotics Institute (Artificial Hands Area) and PERCRO laboratory of Scuola Superiore Sant'Anna (Pisa, Italy).

Main activity

Development of a teleoperated robotic system, a demonstrator shown during the first (2018) and second (2019) edition of Focus Live, the Festival of science held in Milan (Italy).

I collaborated with the team led by Prof. Antonio Frisoli (PERCRO laboratory) and with the team led by Dr. Ing. Marco Controzzi (Artificial Hands Area), to develop a Mono (2018) ad Bi-manual (2019) robotic system teleoperated by means of an exoskeleton. The system comprised of two UR5 robotic arms (Universal Robot) equipped with the robotic hands IH2 Azzurra and Mia Hand (Prensilia srl) and was teleoperated using the ALEX exoskeleton (Wearable Robotics srl).

July 2017 – October 2017

Research fellow at The BioRobotics Institute (Artificial Hands Area), Scuola Superiore Sant'Anna (Pisa, Italy).

Main activity

Development of a collaborative robotic bartender.

I developed the "RoboBarman", a demonstrator shown during the opening ceremony of the International Robotic Festival held in Pisa on September 2017. The demonstrator was built using UR5 robotic arm (Universal Robot) equipped with an IH2 Azzurra robotic hand (Prensilia srl) as end-effector. For this application, I also developed a C# custom application and GUI, running on a tablet. The users selected the drink on the tablet screen and the application sent the order to the robot using MODBUS communication protocol. Once the robot received the request, it took the proper glass and ingredients and prepared the selected drink in front of users. I programmed the robot motions using the URScript Programming Language (Universal Robot).

EDUCATION AND TRAINING

April 2020

Training for robotic application developer using Robot Operating System (ROS), re.je architects + robotics, London (United Kingdom).

Skills covered

- Linux Introduction and shell basics.
- Python scripting.
- ROS programming and tools.
- Robot description and transforms (URDF files).
- Introduction to robotic manipulation with MoveIt..
- Introduction to localization and mapping using SLAM.
- Introduction to navigation with path planning.
- Introduction to state machine-based programming.

June 2019

Visiting student at the Extreme Robotics Laboratory, School of Metallurgy and Materials, University of Birmingham (United Kingdom).

Main activity

Investigating how the grasp strategy of a robot passer influences the performance and quality of robot-human handover.

My collaboration with the University of Birmingham aimed to test whether robotic grasping strategy influences not only robot-human handover but also the performance of humans during subsequent tasks. To this aim, we carried out an experiment asking participants to receive objects from a KUKA iiwa robot (KUKA AG) and complete a manipulative task. The robot exploited two different grasping strategies to pass the objects. We recorded and analysed the participants' performances and perceptions with both the strategies, and we compared them.

Skills covered

- Basic experience with xxxx
- Signal processing (Matlab, MathWorks, Inc.).

- Statistical analysis (SPSS, IBM).

April 2018 – June 2018

Visiting student at the xxxxx.

Main activity

Investigating the human choice of grasp type and location when handing over an object in order to improve robotic grasping.

My collaboration with the xxx aimed to develop new control strategies to improve human-robot physical collaboration. To this end, I investigated the grasp strategies used by humans to exchange objects with a partner and I developed a grasp taxonomy for collaborative actions that can be implemented on a robotic platform.

Skills covered

- Tracking of human motion (OptiTrack capture system, NaturalPoint, Inc.).
- Signal processing (Matlab, MathWorks Inc.).
- Statistical analysis (SPSS, IBM).
- Basic experience with Kinova robots (Kinova Inc.) and ROS programming and Python language.

Tutor

Dr. Ing. xxx.

Collaborators

Prof.xxx, Dr.xxx .

November 2017 – February 2018

Qualification to exercise the profession of Engineer (section A Ind), University of Pisa – Department of industrial engineering (Italy).

Activity

2 oral and 2 written examinations on main subjects about the profession of Biomedical Engineer (according to Italian legislation).

October 2017 – Now

PhD Student, at The BioRobotics Institute (Artificial Hands Area), Scuola Superiore Sant'Anna (Pisa, Italy).

Thesis

Human-inspired control strategies to allow fluent robot-to-human handover. (Thesis defense expected by January 2021).

One of the most common and useful collaborative tasks is object handover. For this reason, I have been investigating the strategies used by humans during handover in order to gather useful insights for improving the efficiency and fluency of human-robot collaboration. In particular, I am focusing on three main aspects of the hand-over: grasping strategies, grasp force modulation, and sensorimotor communication. The final goal of the project is to implement an integrated system using various sensory inputs (such as visual feedback, force sensing, gaze tracking, etc.) to handle fluent and safe human-robot handover.

Recently, I also started a collaboration with PERCRO Lab of the Scuola Superiore Sant'Anna aiming at implementing and testing the control of IH2 Azzurra and MIA robotic hands using hand-arm exoskeletons.

Skills covered

- UR script programming (Universal Robot).
- Signal processing (Matlab, MathWorks Inc.).
- Statistical analysis (Matlab, MathWorks Inc.; SPSS, IBM).
- C# programming.
- Design of experimental protocols regarding multi-agent actions (human-human and human-robot interaction).
- Design and implementation of custom data acquisition systems.

**Supervisor
Tutor**

Dr. Ing. xxx

Prof. xxx and Prof. xxx.

Courses

Human and Animal Models for BioRobotics, Academic English, Graphical programming for measurement test, and control systems in bioengineering (LabVIEW, National Instruments corp.), Statistics and Data Analysis using Matlab, Computer integrated image-based technologies for

robotics (ImageJ).

July 2017

Training for System Integrator of Universal Robots, Fortek srl (San Benedetto del Tronto, Italy).

Skills covered

- Hardware Installing and safety configuration of Universal robots.
- PolyScope basic and advanced commands.
- UR script programming.
- Communication protocols suitable for universal robots.
- URcaps.

December 2014 – April 2017

Master's degree in biomedical engineering, University of Pisa – Department of industrial engineering (Italy).

Final grade: 110/110 cum laude.

Work thesis carried out at the BioRobotics Institute (Artificial Hands Area), Scuola Superiore Sant'Anna, Pisa (IT).

Master Thesis

Development of a bio-inspired algorithm for robot-to-human object handover.
 "Sviluppo di un controllo bio-ispirato per lo scambio di oggetti in task collaborativi uomo-robot."

Object handover is one of the most important joint actions for humans. I investigated the role of tactile and visual sensory information in the modulation of human passers' grip force profile. Afterward, I developed and test a control algorithm based on the achieved results. This algorithm enables a robotic hand to pass objects to human partners fluently and safely, adapting the release dynamic according to receivers' behaviour.

Skills covered

- C# code to control the robotic hand IH2 Azzurra based on signals acquired from external sensors.
- Data processing and analysis.
- Design of experimental protocols regarding human-robot interaction.

Tutors

Dr. Ing. xxx and Prof. xxx.

Courses

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|---|-------------------|
| ▪ Thesis Dissertation | 30/30 |
| ▪ Modeling and analysis of biomedical signals | 30/30 |
| ▪ Radiation bioengineering | 29/30 |
| ▪ Health economics and management | 30/30 "cum laude" |
| ▪ Biomedical electronics | 28/30 |
| ▪ Mechanics of skeletal muscles (Biomechanics) | 28/30 |
| ▪ Biomedical electromagnetic analysis instruments | 30/30 |
| ▪ Rehabilitation engineering | 30/30 |
| ▪ Cellular Biomolecular engineering | 29/30 |
| ▪ Multiscale mechanics of biological and biomimetic systems | 27/30 |
| ▪ Micro and Nano-systems | 30/30 "cum laude" |
| ▪ Medical Robotics | 30/30 "cum laude" |

October 2011 – December 2014

Bachelor's degree in biomedical engineering, University of Pisa – Department of industrial engineering

Final grade: 110/110.

Work thesis carried out at the research center "E. Piaggio", University of Pisa (IT).

Master Thesis

Quantitative analysis of SOFT-MI technique efficiency.
 "Analisi quantitativa dell'efficienza della tecnica SOFT-MI".

SOFT-MI is a recent technique exploited in tissue engineering. This technique is useful for the creation of scaffold reproducing extracellular matrix properties. It combines photolithography processes with molecular imprinting. In order to evaluate the efficiency of this technique, I used this technique to create PMMA scaffolds that I bathed in different polymeric solutions. Afterward,

scaffolds were analysed with a spectrofluorometer and optical microscopy evaluating how many proteins were bounded.

- Skills covered**
- Photolithography fabrication of micro-structures on silicon wafer.
 - Modification of PDMS surface properties to enhance bounding capabilities with proteins.
 - Image processing using through automatic algorithms (Matlab, Mathworks Inc. and ImageJ).
 - Experience with chemical equipment including spectrofluorometer and optical microscopes.

Tutors Prof. xxx and Dr. xxx.

Courses	<ul style="list-style-type: none"> ▪ Thesis Dissertation ▪ Mathematica analysis I ▪ Linear algebra and Mathematica analysis II ▪ Biochemistry ▪ Numerical computation ▪ Chemistry ▪ General physics I ▪ Computer science ▪ Biomedical signals analysis ▪ Automation system ▪ Economics and company organization ▪ Electronics ▪ Electrical engineering ▪ General physics II ▪ Human physiology ▪ Mechanics ▪ Radiation protection ▪ Chemical bioengineering and transport phenomena ▪ Biomaterial and prosthetic implants ▪ Tissue biomechanics and biomedical artificial system ▪ Statistical analysis (Biostatistics) ▪ Material science and technology ▪ English test (B1 level) 	<p>30/30</p> <p>27/30</p> <p>29/30</p> <p>30/30</p> <p>22/30</p> <p>22/30</p> <p>24/30</p> <p>30/30</p> <p>30/30 "cum laude"</p> <p>24/30</p> <p>28/30</p> <p>30/30 "cum laude"</p> <p>30/30 "cum laude"</p> <p>25/30</p> <p>30/30 "cum laude"</p> <p>24/30</p> <p>28/30</p> <p>23/30</p> <p>25/30</p> <p>28/30</p> <p>25/30</p> <p>30/30</p> <p>Passed</p>
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2006 - 2011 **Scientific High school "Liceo Scientifico Ulisse Dini", Pisa, IT.**

Graduated with 91/100.

PERSONAL SKILLS

Mother Tongue Italian

Other languages	READING SKILLS	VERBAL SKILLS	WRITING SKILLS
English	B1	B1	B1

Technical skills and competencies

- Excellent expertise of Matlab code.
- Excellent expertise of C# code.
- Excellent expertise of UR script code (language of Universal Robot series).
- Expertise in python code.
- Expertise in ROS programming.
- Basic expertise in C++, C code.
- Expert user of UR robots (Universal Robot).
- Expert user of IH2 Azzurra (Prensilia srl) robotic hand.
- Expert user of Visual Studio (Microsoft)
- Expert user of Ni-MAX (National Instruments corp.)
- Expert user of SPSS (IBM).
- User of Inkspace and ImageJ

- Expert user of Microsoft Office suite
- Expert user of Windows OS
- Basic user of Ubuntu OS
- Significant experience in ad-hoc experimental design and custom data acquisition systems for scientific experiments.
- Significant experience in data processing and statistical analysis
- Good experience in image processing and analysis
- Basic experience of chemical equipment including spectrofluorometer and optical microscopes
- Basic experience in photolithography processes and microfabrication
- Basic experience in surface chemical modification of PDMS and molecular imprinting

- General skills
- Teamwork and individual work attitude developed during the academic career
 - Ability to work in stressful conditions

Driving license

PUBLICATIONS

F.Cini, T.Banfi, G. Ciuti, L. Cragighero, M. Controzzi, "Relevance of warning signal timing in human-robot manipulative teamwork". *Science Robotics*, Under-Review, nov 2020.

V. Ortenzi, F. Cini, T. Pardi, N. Marturi, R. Stolkin, P. Corke, and M. Controzzi, "The grasp strategy of a robot passer influences performance and quality of the robot-human object handover". *Frontiers in Robotics and AI*, vol. 7, pp. 138-149, oct 2020.
[Online]. Available: <https://www.frontiersin.org/articles/10.3389/frobt.2020.542406/full>

V. Ortenzi, M. Controzzi, F. Cini, J. Leitner, M. Bianchi, M. A. Roa, and P. Corke, "Robotic manipulation and the role of the task in the metric of success," *Nature Machine Intelligence*, vol. 1, no. 8, pp. 340–346, aug 2019.
[Online]. Available: <http://www.nature.com/articles/s42256-019-0078-4>

F. Cini, V. Ortenzi, P. Corke, and M. Controzzi, "On the choice of grasp type and location when handing over an object," *Science Robotics*, vol. 4, no. 27, p. eaau9757, feb 2019.
[Online]. Available: <http://robotics.sciencemag.org/lookup/doi/10.1126/scirobotics.aau9757>

M. Controzzi, H. Singh, F. Cini, T. Cecchini, A. Wing, and C. Cipriani, "Humans adjust their grip force when passing an object according to the observed speed of the partner's reaching out movement," *Experimental Brain Research*, vol. 236, no. 12, pp. 3363–3377, dec 2018.
[Online]. Available: <http://www.ncbi.nlm.nih.gov/pubmed/30259134>

ORGANIZATION OF SCIENTIFIC MEETINGS

Organizer of the full-day workshop Shaping the quality metric of a grasp with the manipulation task: grasping as a sub-action of object manipulation at the International conference ICRA2020, held virtually due to the CoVID-19 lockdown.

ADDITIONAL INFORMATION

Awards GNB2017 (Italian National Bioengineering Group) master's thesis award "Luigi Divieti e Marisa Maranzana".

11/01/2021