

PERSONAL INFORMATION

Salvatore D'Avella

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Date of birth [Redacted] | Nationality Italy

WORK EXPERIENCE

01/10/2019 – Present

Ph.D. Student

at PERCRO, School of Advanced Studies Sant'Anna, Pisa (Italy)

- Research on Intelligent Manipulation in Industry 4.0
- Responsible for the development of an industrial cell for Luxottica group capable of loading and unloading eyeglassing on/from a frame built on purposed, taking the eyeglasses from a conveyro belt.

01/06/2019 – 01/10/2019

Postgraduate Research Fellow

at PERCRO, School of Advanced Studies Sant'Anna, Pisa (Italy)

- Automation of an industrial process for Luxottica
- Injector quality inspection for Continental
- Research on pick and place of objects in cluttered environments

EDUCATION AND TRAINING

12/09/2016–03/05/2019

Master Degree in Embedded Computing Systems

ISCED 6

University of Pisa and School of Advanced Studies Sant'Anna, Pisa (Italy)

Marks: ██████████**Thesis:** Autonomous pick and place in cluttered environment**Abstract:**

Robotics solutions in the industrial sector are moving towards higher degrees of flexibility. The challenge of developing flexible solutions where production lines can be quickly re-planned, adapted and structured for new or slightly changed products is still an important open problem. Industrial robots today are still largely pre-programmed for their tasks or to robustly interact with a complex environment and a human worker. In the envisioned future humans and robots will share the same workspace and perform different object manipulation tasks in a collaborative manner. One of the most repetitive tasks for human workers is picking and place of objects. In such a context, the latest research is focused on grasping technologies for material handling and vision systems to automate that task. The aim of this work is to study a possible way to overcome current limitations on the existing robotic solutions for picking objects in cluttered environments.

In this manuscript, a collaborative robotics system, leveraging on Baxter robot as the robotics platform, is presented. It integrates a classical two-finger gripper on one arm and a custom designed soft-robotics end-effector on the other one. This gripper belongs to the category of gripping by controlled stiffness and it is also known as Universal Jamming Gripper (UJG). 3D perception technologies are employed in order to select suitable geometries that exploit at best the advantages of the UJG in picking objects of different shapes. A custom algorithm that selects a suitable picking point, solving the perceptual issues posed by cluttered environments, is introduced. The parallel-jaw gripper is controlled through a state-of-the-art techniques which searches in the point clouds for antipodal grasping points. Both arms are planned using the MoveIt! framework which allows to bring the arm to the grasping point and placing the object to the desired position avoiding collision with the environment.

Grasping tests to assess the capabilities of the custom gripper have been conducted. Moreover, a comparative study of the algorithmic performance of the proposed method with respect to two of the state-of-the-art techniques is presented. One is the work of the MIT-Princeton team that won the first place for the stowing task in the Amazon Picking Challenge in 2017; the other is the approach used for controlling the parallel-jaw gripper. The proposed system is shown to be able to grasp novel objects in a cluttered environment with a competitive grasping success rate, outperforming the other systems in the time spent to find grasping points.

20/09/2013–22/07/2016 Bachelor Degree in Computer Engineering

University of Pisa, Pisa (Italy)

Marks: ██████████

Thesis: Analisi e miglioramento dell'esplorazione di ambienti ad alta densità di ostacoli, con un algoritmo di coordinamento stigmergico per sciame di droni, e collaudo su uno scenario di fughe di gas in area urbana

Abstract:

The constant technological development and the needs of using drones for missions considered dull, dirty and dangerous in inhabited places, with a high density of natural and artificial obstacles, led to their miniaturization. However, exploiting small drones means dealing with equipment of limited capacity and reduced energy autonomy. Exploring a certain area by decreasing the size of the drones needs to increase their number and to coordinate them. The emerging behavior, on which many biological systems are based, such as ant colonies, the swarm of bees or the flock of birds, is a good solution for overcoming such an issue. These are decentralized systems, without anyone telling the individual parties what to do; it is a behavior that is generated by the individual agents that are organized and interconnected with each other but does not belong to any of them. Swarm intelligence derives from these concepts.

The proposed work introduces analysis and improvements of an algorithm for coordinating a swarm of small drones based on stigmergy and flocking. The purpose is to detect targets in synthetic environments or scenes inspired by real scenarios with high intensity of obstacles. Stigmergy is a communication method used in decentralized systems in which the system's agents communicate with each other by modifying the surrounding environment (for example with pheromones). Flocking is a mechanism for organizing a group inspired by the natural behavior of birds. The analysis of this algorithm was conducted through the NetLogo software using a declarative language. Languages of this type are suitable for the study of multi-agent systems because they allow representing the observed behavior without implementing the causes that generated such behavior. That means they allow to explain only the goal to be achieved, leaving the implementation to the supporting software. In particular, the work was focused on monitoring the performance (completion time, false positives/negatives) of the algorithm varying the parameters used to form the swarm and the ones related to the communication between the agents using virtual pheromones. Furthermore, the thesis activity took care of the modification of the code for bug fixes and the exploration of new strategies. The experiments were conducted not only on the existing synthetic scenarios but even on a new one with a high density of obstacles. It was reproduced on purpose in NetLogo starting from a real scenario regarding an urban area of Massachusetts (Boston) with lots of gas leaks. Finally, a Java program was created for processing automatically the outputs of the algorithm. The obtained results show a considerable improvement, especially for what concerns the execution time.

15/09/2008–15/07/2013 Liceo Classico Graduation

Liceo Classico Pietro Colletta, Avellino (Italy)

Marks: ██████████

PERSONAL SKILLS

Mother tongue Italian

Other languages	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	B2	C1	B2	B2	B2
PET					

Levels: A1 and A2: Basic user – B1 and B2: Independent user – C1 and C2: Proficient user
[Common European Framework of Reference for Languages](#)

Communication skills Excellent interpersonal and communication skills gained during university group projects and thanks to the study and cooperative research with colleagues.

Organisational / managerial skills Ability to work in situations of stress related to the deadlines of work projects.

Job-related skills Knowledge of different programming and scripting languages, RDBMs and Web technologies:

- C/C++
 - Java
 - HTML5, Javascript, PHP, CSS3, Bootstrap, Polymer
 - MySQL
 - Python
 - Bash
 - MATLAB, Simulink, sisotool, RoboticsToolbox
 - RAPID
- Knowledge of different frameworks:
- OpenCV
 - Dlib
 - Om2m
 - XVR
 - ROS
 - ROS-Industrial (abb_iergm, abb_librws, abb_driver)
 - Solidworks
 - Arduino
 - Papyrus, Accileo
 - VHDL, Xilinx Vivado Design Suite
 - LTSA, Uppal
 - Docker
- Skills regarding the implementation of embedded systems, and control and vision systems applied to robotics.

Digital competences
SELF-ASSESSMENT

Information Processing	Communication	Content creation	Safety	Problem solving
Proficient user	Proficient user	Proficient user	Proficient user	Proficient user

Digital competences - Self-assessment grid

ECDL

Digital skills Excellent office suite skills. Knowledge of LaTeX. Expertise in the creation of digital presentations and photo editing programs.

Driving licence ■

PROJECTS

Elevators
project developed for the Real Time
part of the course of Real Time and
Distributed Systems

Abstract: Simulate N elevators in a building with M floors. People using the elevators are randomly generated. Elevators must allow clients to book the requests and stop to floors in the desired sequence. Elevator must move smoothly as controlled by motors. The lift stops are managed according to the SCAN algorithm. The speed profile of the elevators has been designed with a trapezoidal shape for guaranteeing a smooth path. The control of the elevator is simulated using a digital controller that works on a DC motor. Each elevator and each customer is implemented as a thread. All the parameters of the simulation can be changed using a configuration file. Six different types of tasks have been defined: Graphics, Elevator, Client, Control, Command, Spawner. Each of them has its own priority, period and deadline. The shared data structures have been protected using mutexes. HLP has been used as the resource access protocol for mutexes given the numerous critical nested sections. The system was implemented in C++ according to the MISRA criteria and the graphics interface was developed with Allegro.

FairLock
project developed for the
Distributed Systems part of the
course of Real Time and
Distributed Systems

Abstract: Implement a synchronization mechanism similar to the one provided by Java within the `java.util.concurrent` package (explicit Lock and Condition variables) but whose behavior is in accordance with the semantic "signal-and-urgent". The implementation must guarantee that threads waiting to acquire a FairLock are awakened in a FIFO order. As a simple example of the use of the previous mechanism, it has been implemented a manager of a single resource that dynamically allocates the resource to three client threads: ClientA1, ClientA2, and ClientB. If the resource is in use by ClientA1 or by ClientA2, when it is released and both ClientB and the other ClientA are waiting for the resource, ClientB must be privileged. It is also provided the implementation of the same manager using the analogous mechanism provided by Java whose behavior is in accordance with the semantics "signal-and-continue" pointing out the differences between the two implementations. Finally using the language FSP, the design model of the previously described example has been provided. Then, from the design model, the corresponding Java program implemented by using the Lock and Condition variables is presented. By modeling this implementation with the FSP language, it has been verified that it satisfies the problem's specification.

Line Follower
project developed for the course of
Design of Embedded Systems

Abstract: Development of a line follower robot capable of following a black line on a white background. The project involved the assembly of all the parts of the prototype using the Tamiya kit as well as the design of the necessary electronics. The two DC motors are controlled by a Pololu TB6612FNG driver in PWM while the Pololu QTR-8A sensor, with 8 reflection sensors, is used for the localization of the line. The control board is a STM32F24Discovery which implements a PID controller in a single periodic task on the Erika operating system. The code is tested with the CUnit suite.

Modified Multi-proc
project developed for the course of
Dependable Systems

Abstract: Modification of the Multi-proc tutorial of the Mobius tool considering the error handler module and the I/O port module as fully reliable. Furthermore, the system is considered as operating if at least two computers are running. The reliability of the system is evaluated after twenty years by varying the number of computers from two to three and changing the chip failure rate within a predefined interval. Finally, the reliability of the system is compared to the simplex system (one computer).

Secure Sequence Detector
project developed for the course of
Digital Systems

Abstract: Implementation and design in VHDL of a sequence detector of five numbers expressed on 8 bit. The automaton receives as input the eight bits, a first and a reset signal along with the clock. The detector outputs an unlock and a warning signal for managing some specific cases described by the specification. The system was simulated in MATLAB Simulink through an extended FSM before of being implemented in VHDL. The implementation was then tested using the Testbench for all the critical conditions. The code was synthesized and implemented on the Zybo xc7z010clg400-3 using the Xilinx Vivado Design Suite tool focusing on the maximum frequency, the critical path, and the used resources.

Color Patches Comparator
project developed for the course of
Computational Intelligence

Abstract: Design and development of a system based on neural networks for comparing two color patches and measuring their similarities. The two patches are a master of an industrial printing process and a copy that tries to be as much similar as possible to that master. The neural network was created in MATLAB. It receives as input the spectrum of both the master and the copy appropriately sampled. The system outputs the degree of similarity between the two colors. Starting from the reflected spectral reflectance curve of the master, the color is calculated in the XYZ space using the color matching functions XYZ CIE 1931 2-degree and the illuminant D65 sampled at 1 nm. Then, the RGB and the $L^* a^* b^*$ spaces are obtained from the XYZspace. The distance between the two colors is measured using the DeltaEfunction (Euclidean distance). The training set for the neural network is generated manually. Through a hierarchical clustering, based on the Euclidean distance of the masters, the representative samples of the entire working space are recognized in the centroids of the clusters. The copies were generated by adding white Gaussian noise those masters (centroids), perturbing each band of the color spectrum. The labeling process was performed, first through an HTML page, and then using an interface created with the MATLAB-GUI tool. The interface gave the possibility to choose among three linguistic variables: different, slightly different and identical. After balancing the data set, two different types of networks, MLP (patternet) and RBF (newrb), were tested. For what concerns the MLP network, the Scale Conjugate Gradient was used as the training algorithm, cross-entropy as the performance function exploiting the cross-validation technique. Several experiments were conducted taking into account different numbers for the first and the second level of hidden layers to figure out the best architecture. In the same way, the performance of the RBF network was examined with different spread values and changing the maximum number of neurons.

Smart Shoes
project developed for the course of
Innovation and Industrial
Application

Abstract: The project concerns the study and the development of an innovative idea from an industrial perspective. In that case, the idea regards smart shoes. The workflow starts analyzing the literature about smart shoes in the fields of health-care and fitness. It was requested to write a paper involving the state-of-the-art methods, highlighting the barriers against the adoption of smart shoes and showing the innovation introduced by the proposed system to overcome such barriers. As a further step, the product requirements, from the requested functionalities to the functional and non-functional requirements, were defined. The profile of the final customer was also taken into account for commercial purposes. Therefore, the hardware and software technologies needed for realizing the product were investigated and the business model was prepared. Finally, a prototype of the shoes able to measure the pressure on the front and the back of the foot, the humidity, and temperature, was realized. The data acquired by the sensors were transferred via USB or wireless to the PC and then visualized on a multi-platform Web App developed using JxBrowser and JavaFX.

Intelli Domus
project developed for the course of
Internet of Things

Abstract: This project applies the technologies of the Internet of Things to the field of home automation, creating a management system for monitoring some important measures of the house. In particular, three aspects are taken into account: safety (intrusion, fire, flooding), brightness and temperature (and humidity). The sensors and the actuators are programmed using Contiki as the operating system and CoAP as the high-level protocol. They were simulated in Cooja by creating a 6LoWPAN network that, communicating with the Gateway, interacts with OM2M. The Gateway runs a Java program that performs the discovery of the motes, communicates with them and acts as a proxy for OM2M. There is one MN for each house and a single IN that uses different Access Control Policies and has a different AE for each home. A Web App, realized using Polymer and Javascript, allows remote access for monitoring all the information of the house or controlling the actuators, from a smartphone or a PC. The backend of the application was developed in Node.js.

RoboPong
project developed for the course of
Robotics and Human-Machine
Interfaces

Abstract: The project presents N robots (Puma 560) that interact with each other in a game similar to ping-pong. The adopted frameworks are MATLAB and Robotics Toolbox by Peter Corke. Only the cinematic aspect of the problem has been addressed. The ball moves with a parabolic motion, and at any time the system is assumed to know its position without the use of computer vision techniques. Every 100ms, each robot checks if the ball will enter its workspace. If this occurs, an inverse kinematics problem is solved for letting the robotic arm to be at time t_+ in the position where the ball will enter its workspace. The pose of the end-effector must be such as to give sufficient speed to the ball for allowing it to reach the next manipulator. The bounce of the ball is managed to assume the conservation of momentum in the x and y-axis, so that only the direction will change according to the law of reflection.

PUBLICATION

- [1] Salvatore D'Avella, Paolo Tripicchio, and Carlo Alberto Avizzano. "A study on picking objects in cluttered environments: Exploiting depth features for a custom low-cost universal jamming gripper". In: *Robotics and Computer-Integrated Manufacturing* 63 (2020), p. 101888.
- [2] Paolo Tripicchio, Salvatore D'Avella, Carlo Alberto Avizzano, Fabrizio Di Pasquale, and Philippe Velha. "On the integration of FBG sensing technology into robotic grippers". In: *The International Journal of Advanced Manufacturing Technology* 111.3 (2020), pp. 1173–1185.
- [3] Paolo Tripicchio, Gerardo Camacho-Gonzalez, and Salvatore D'Avella. "Welding defect detection: coping with artifacts in the production line". In: *The International Journal of Advanced Manufacturing Technology* 111.5 (2020), pp. 1659–1669.
- [4] Salvatore D'Avella and Paolo Tripicchio. "Supervised stowing as enabling technology for the integration of impaired operators in the industry". In: *Procedia Manufacturing* 51 (2020), pp. 171–178.
- [5] Paolo Tripicchio and Salvatore D'Avella. "Is Deep Learning ready to satisfy Industry needs?" In: *Procedia Manufacturing* 51 (2020), pp. 1192–1199.

Conferences – 29th International Conference on Flexible Automation and Intelligent Manufacturing: 24th - 28th June 2019 at University of Limerick. Conference Theme: Beyond Industry 4.0: Industrial Advances, Engineering Education and Intelligent Manufacturing

Presentations – Presenter of the paper A study on picking objects in cluttered environments: exploiting depth feature for a custom low-cost Universal Jamming Gripper to the FAIM 2019 conference: 24th - 28th June 2019.

ADDITIONAL INFORMATION

Processing of personal data

- Ita:
Autorizzo il trattamento dei dati personali contenuti nel mio curriculum vitae in base all'art. 13 del D. Lgs. 196/2003 e all'art. 13 del Regolamento UE 2016/679 relativo alla protezione delle persone fisiche con riguardo al trattamento dei dati personali.
- Eng:
I authorize the processing of personal data contained in my curriculum vitae based on art. 13 of Legislative Decree 196/2003 and art. 13 of EU Regulation 2016/679 concerning the protection of individuals with regard to the processing of personal data.