September – 2021

COMMANDIA NEWSLETTER

http://commandia.unizar.es

Collaborative Robotic Mobile Manipulation of Deformable Objects in Industrial Applications

May 18, 2021

Special Issue - IEEE Robotics and Automation Letters

https://www.ieee-ras.org/publications/ra-l/special-issues/cfp-robotic-handling-of-deformable-objects

CFP: Robotic Handling of Deformable Objects
Motivation

There is a growing interest in the robotics community to investigate the handling of deformable objects. The ability to interact with deformable objects promises new applications for robots: cable assembly in industrial settings, doing laundry in households, dressing assistance in elderly care, organs and tissues manipulation in surgical operations, or fragile samples collection in underwater/space robotics, to name a few. However, deformable objects are considerably more complex to deal with than rigid ones. Specifically, some of the new challenges involved in handling object deformation are the following:

-The difficulty of sensing the deformation,
-The infinite degrees of freedom of the deformation configuration,
-The complexity of the high nonlinearity in modeling the deformation.

As a result, there is a necessity for novel methodological and technological approaches in this field, and these advances need to cover the full spectrum of robotic problems and tasks (perception, modeling, planning, and control).

Therefore, the aim of this special issue is to collect the latest research results that handle deformable objects in various robotic applications.
List of topics

Topics of interest for this special issue include and are not limited to:
-Sensing (e.g., vision, tactile) of deformable objects
-Robotic manipulation of deformable objects (planning, control, grasping, grippers design, etc.)
-Modeling of deformable objects for robotic handling
-Multi-robot and human-robot handling of deformable objects
-Benchmarking robotic handling of deformable objects
-Robot learning for handling deformable objects
-Mobile manipulation of deformable objects (with legged, wheeled, aerial or underwater robots)

http://commandia.unizar.es/2021/05/special-issue-ieee-robotics-and-automation-letters/

Guest Editors of the Special Issue
Jihong Zhu
(TU Delft/Honda Research Institute Europe, Netherlands/Germany)
Claire Dune
(Laboratoire COSMER – EA 7398, Université de Toulon, France)
Miguel Aranda
(CNRS, Clermont Auvergne INP, Institut Pascal, Université Clermont Auvergne, France)
Youcef Mezouar
(CNRS, Clermont Auvergne INP, Institut Pascal, Université Clermont Auvergne, France)
Juan Antonio Corrales
(University of Santiago de Compostela, Spain)
Pablo Gil
(University of Alicante, Spain)
Gonzalo López-Nicolás
(University of Zaragoza, Spain)

April 1, 2021

CALZADO
People from INESCOP (José F. Gómez, José M. Gutiérrez, Jesús Arregui y Maria D. Fabregat) have published the article “Robots para el ensamblado de calzado” in the journal “Revista del Calzado”.

http://revistadelcalzado.com/robots-para-el-ensamblado-de-calzado/

Sponsoring: Project COMMANDIA (SOE2/P1/F0638) is partially supported by Interreg Sudoe Programme and European Regional Development Fund (ERDF).

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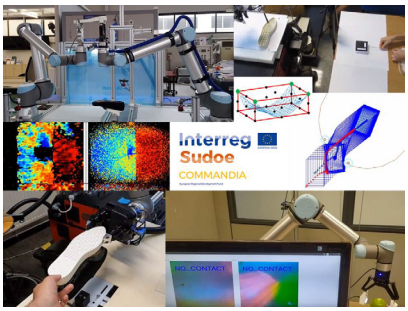
July 6, 2021

COMMANDIA meeting

All the partners of the SUDOE project COMMANDIA have meeting today on July 6, 2021 to present and discuss their latest advances.

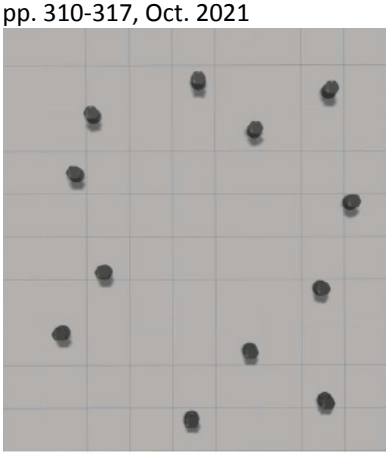


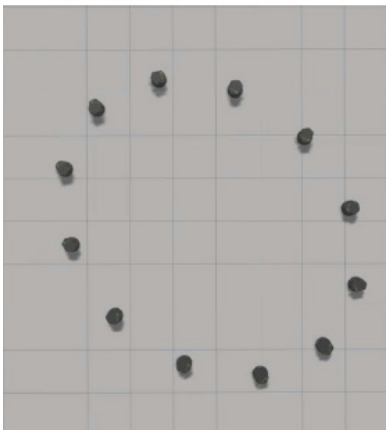
August 1, 2021

Paper: Distributed Linear Control of Multirobot Formations Organized in Triads

Authors: M. Aranda, G. López-Nicolás and Y. Mezouar

Journal: IEEE Robotics and Automation Letters, vol. 6, no. 4, pp. 310-317, Oct. 2021





Abstract: This letter addresses the problem of controlling multiple robots to form a prescribed team shape in two-dimensional space. We consider a team organization in interlaced triads (i.e., groups of three robots). For each triad we define a measure of geometric deformation relative to its prescribed shape. Our main contribution is a novel distributed control law, defined as the gradient descent on the sum of these triangular deformation measures. We show that this geometrically motivated control law is linear, and bears analogies with existing formulations. Moreover, in comparisonwith these formulations our controller is simpler and more flexible to design, converges to the globally optimal shape by construction, and allows analysis of the team size dynamics. We illustrate the proposed approach in simulation.

Download paper

August 20, 2021

Final event of COMMANDIA Project

Join us in the final event of Project COMMANDIA!

This will be an online dissemination meeting held via Zoom on 30th September. During this event the results obtained in the COMMANDIA project will be disseminated to the public.

COMMANDIA stands for Collaborative Robotic Mobile Manipulation of Deformable Objects in Industrial Applications. This is a project supported by the Interreg Sudoe Programme, which is financed by the European Regional Development Fund

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(ERDF). The main goal of this project is to improve the competitiveness and work conditions of industries where deformable objects have to be manipulated directly by human operators in order to control their shapes during production.

The event will first present the framework of COMMANDIA. After the introduction and summary of the project, the event will continue with the presentations from the different partners of the consortium (SIGMA Clermont, INESCOP, Universidad de Zaragoza, Universidad de Alicante, Universidade de Coimbra) with special emphasis on technical, scientific, dissemination activities and achievements. To conclude, a round table with open live discussion will be held with the participants in the event.

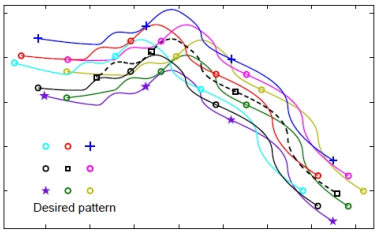
Date: 30 September 2021
Time: 9:30 AM to 12:30 PM, Paris time
Place: Zoom

September 1, 2021

Paper: Enclosing a moving target with an optimally rotated and scaled multiagent pattern

Authors: M. Aranda, Y. Mezouar, G. López-Nicolás, C. Sagüés

Journal: International Journal of Control, vol. 94, no. 3, pp. 601-611, 2021



Abstract: We propose a novel control method to enclose a moving target in a two-dimensional setting with a team of agents forming a prescribed geometric pattern. The approach optimises a measure of the overall agent motion costs, via the minimisation of a suitably defined cost function encapsulating the pattern rotation and scaling. We propose two control laws which use global information and make the agents exponentially converge to the prescribed formation with an optimal scale that remains constant, while the team's centroid tracks the target. One control law results in a multiagent pattern that keeps a constant orientation in the workspace; for the other, the pattern rotates with constant speed. These behaviors, whose optimality and steadiness are very relevant for the task addressed, occur independently from the target's velocity. Moreover, the methodology does not require distance measurements, common coordinate references, or communications. We also present formal guarantees of collision avoidance for the proposed approach. Illustrative simulation examples are provided.

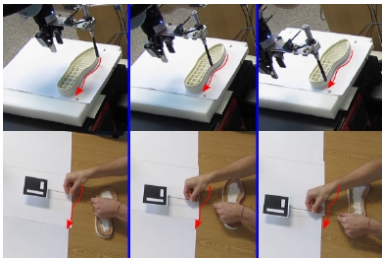
Download paper

Sept. 15, 2021

Student degree projects at UNIZAR on September 2021

Different students have presented their final degree projects in the framework of COMMANDIA:

"Development of a practical demonstrator in ROS for the UR10 robot manipulator" by Ignacio Herrera Seara

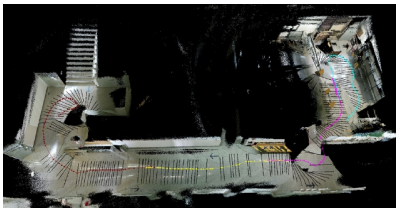


In this work, the UR10 collaborative robot has been used together with the ROS environment for the development of several practical applications, which have been tested both in simulation and in a real environment. The control of the robot movements has been developed through the MoveIt framework. The implemented applications have been the following: making drawings on a canvas by the robot, extraction and drawing of contours of real

Sponsoring: Project COMMANDIA (SOE2/P1/F0638) is partially supported by Interreg Sudoe Programme and European Regional Development Fund (ERDF).

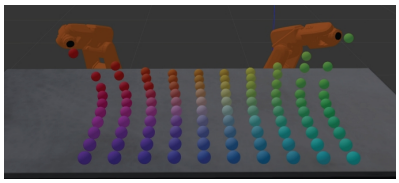
objects and, finally, teleoperation of the robot. In addition, the last two applications make use of the RGB-D Realsense D435 camera for their operation.

"Multi-camera mapping with RGB-D sensor" by Juan García-Lechuz Sierra



As with people, many tasks assigned to robots require the coordination of several of them to be carried out. One of them is the perception of the environment, when it has a certain complexity and its analysis is too computationally or time-consuming. For this coordination to be effective, the development of collaborative techniques that take into account the variability of the environment and result in a robust analysis of the environment and as complete as possible is required. The objective of this work is to obtain the representation in three dimensions of different environments, using a moving RGB-D sensor together with an application that allows its development in several sessions, representing the joint work between several cameras placed in different mobile robots to generate a single map. In addition, the My Find Object application is developed to censor objects and surfaces during the generation of the map, processing the images obtained by the RGB-D sensors to eliminate the information of these objects before it is introduced in the application from which the representation in three dimensions is obtained.

"Deformable object manipulation in multi-robot environments" by Andrés Otero García



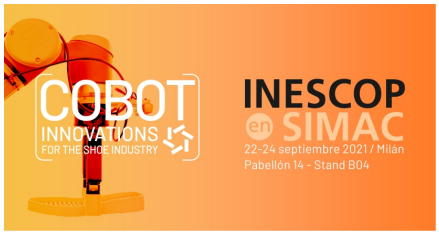
A case is studied in which multiple IRB120 robots from ABB manipulate simultaneously a deformable object, such as a cloth. The objective is to develop a simulation in which at least two robots can perform synchronized movements to make changes in the deformable object, such as displacement or deformation, without colliding with the object during manipulation.

Sept. 20, 2021

INESCOP at SIMAC 2021

We are happy to announce that INESCOP will present COMMANDIA results in SIMAC 2021.

SIMAC is the International exhibitions of machines and technologies for footwear, leather goods and tanning industry (22-24 September 202, at Fiera Milano Rho, Italy). At SIMAC TANNING TECH you'll find the most important manufacturers of machines for footwear manufacturing, leather goods and tanneries, accessories and component, chemical products, prototyping systems, lab machinery and equipment, consumables, automation, waste treatment systems and equipment, moulds and die cutters, management and production cycle, logistics, finished-product testing, conveyor systems, etc.



You are welcome to visit us in booth B04 at pavilion 14 from 22nd to 24th of September. See more details here.

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You can also take a look to this video for an introduction to the COMMANDIA results.

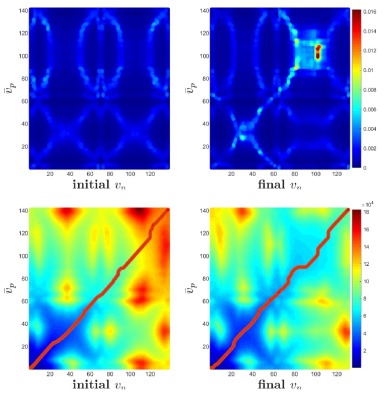
Sept. 27, 2021

Paper: Multi-scale Laplacian-based FMM for shape control

Title: Multi-scale Laplacian-based FMM for shape control

Authors: Ignacio Cuiral-Zueco and Gonzalo Lopez-Nicolas

Conference: 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). September 27 – October 1, 2021. Prague, Czech Republic



Abstract: Shape control has become a prominent research field as it enables the automation of tasks in many applications. Overall, deforming an object to a desired target shape by using few grippers is a major challenge. The limited information about the object dynamics, the need to combine small and large deformations in order to achieve certain target shapes and the non-linear nature of most deformable objects are factors that significantly hamper shape control performance. In this paper, we propose a shape control method for multi-robot manipulation of large-strain deformable objects. Our approach is based on multi-scale Laplacian descriptors that feed an FMM (Fast Marching Method) for elastic shape contour matching. The FMM's resulting path and the Laplacian operator are used to define a control strategy for the robot grippers. Simulation experiments carried out with an ARAP (As Rigid As Possible) deformation model provide satisfactory results.

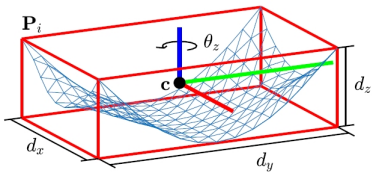
Download paper

Sept. 28, 2021

Paper: Collision-free Transport of 2D Deformable Objects

Authors: Rafael Herguedas, Gonzalo Lopez-Nicolas, Carlos Sagues

Conference: International Conference on Control, Automation, and Systems (ICCAS 2021), Jeju, Korea, October 12-15, 2021



Abstract: We propose a novel system to transport 2D cloth-like deformable objects with mobile manipulators and without collisions along a known path. First, a new deformation model that allows for real-time shape prediction, based on the paradigm of deformable bounding box, is presented. The transport task is next defined as an optimization problem, which includes a set of linear and nonlinear constraints. These constraints allow to limit the object's deformations and rotations and to avoid obstacles, respectively. Simulation results are reported to demonstrate the validity of our method.

Download paper

October 1, 2021

COMMANDIA final event

The final event of the Interreg Sudoe Project COMMANDIA was successfully held last September 30th as an online event. A summary of the project was presented by the coordinator of the project, Youcef Mezouar. After the introduction and summary of the project, the event continued with the presentations from the different partners of the

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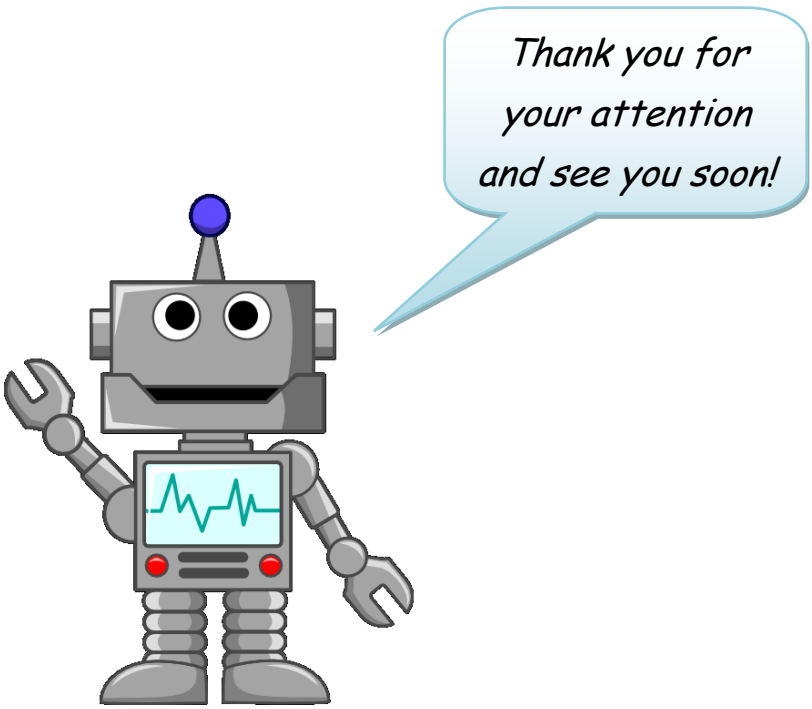
consortium with special emphasis on technical, scientific, dissemination activities and achievements. To conclude, a round table with open live discussion was held with the participants in the event.

You can find a video with that motivates Project COMMANDIA in the following link. Another video here gives an introduction and overview of the project goals. One of the results of the project is a demonstrator that implements some of the techniques developed within the project to manipulate deformable objects. This is explained in this video.

During the COMMANDIA final event we had the opportunity to learn about the work that five partners (SIGMA, U. Alicante, INESCOP, U. Zaragoza, U. Coimbra) developed across three countries (Portugal, Spain, France) on the topic of Collaborative Robotic Mobile Manipulation of Deformable Objects in Industrial Applications. We would also like to take this opportunity to thank all those involved in the success of this project.



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