March – 2021

COMMANDIA NEWSLETTER

http://commandia.unizar.es

Collaborative Robotic Mobile Manipulation of Deformable Objects in Industrial Applications

October 12, 2020

Workshop ROMADO at IROS 2020

We are preparing a workshop on Robotic Manipulation of Deformable Objects (ROMADO) at IROS 2020. Notice that IROS 2020 will not be held in-person due to the COVID-19 pandemic. Instead, the contents of the conference will be provided on the IROS On-Demand platform. This platform will be used to present the contents of this workshop.

This year the access to all the conference contents is free, check details at IROS 2020 web.

More details about the workshop with the list of invited speakers and contributed papers can be found in the workshop web. In the meanwhile, take a look to this introduction video of the workshop ROMADO:

October 25, 2020

Digital transformation in footwear

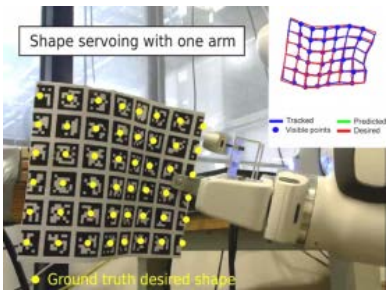
The industry in general, and the footwear industry in particular, are going through a digital transformation in every sense. With the arrival of the new industrial revolution, known as Industry 4.0, the existing concepts and technologies that were to come and that were going to change the manufacturing and sales processes of products were identified.

INESCOP participated in the online conference "Transformación digital en calzado" which was held on October 6th, 2020. In this conference on "Digital Transformation in Footwear", we will be able to see those challenges and opportunities that digitalization offers us, from the initial stages of product definition, through manufacturing and production management to the possibilities offered to us to reach the end consumer thanks to new technologies based on the cloud and online sales.
Website

November 1, 2020

Paper: Monocular visual shape tracking and servoing for isometrically deforming objects

Author: Miguel Aranda, Juan Antonio Corrales Ramon, Youcef Mezouar, Adrien Bartoli, Erol Özgür
Conference: 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), October 25-29, 2020, Las Vegas, NV, USA.



Abstract: We address the monocular visual shape servoing problem. This pushes the challenging visual servoing problem one step further from rigid object manipulation towards deformable object manipulation.

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

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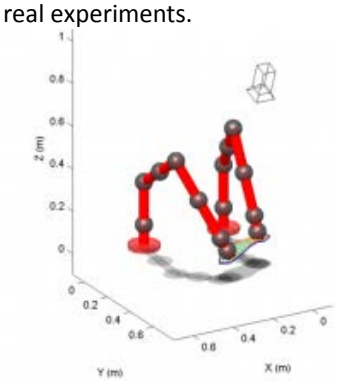
Collaborative Robotic Mobile Manipulation of Deformable Objects in Industrial Applications

Explicitly, it implies deforming the object towards a desired shape in 3D space by robots using monocular 2D vision. We specifically concentrate on a scheme capable of controlling large isometric deformations. Two important open subproblems arise for implementing such a scheme. (P1) Since it is concerned with large deformations, perception requires tracking the deformable object's 3D shape from monocular 2D images which is a severely underconstrained problem. (P2) Since rigid robots have fewer degrees of freedom than a deformable object, the shape control becomes underactuated. We propose a template-based shape servoing scheme in which we solve these two problems. The template allows us to both infer the object's shape using an improved Shape-from-Template algorithm and steer the object's deformation by means of the robots' movements. We validate the scheme via simulations and real experiments.

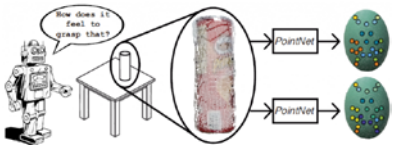


Paper download

November 7, 2020

Paper: Generation of tactile data from 3D vision and target robotic grasps

Autor: B.S. Zapata-Impata, P. Gil, Y. Mezouar, F. Torres
Journal: IEEE Transactions on Haptics, July 2020



Abstract:Tactile perception is a rich source of information for robotic grasping: it allows a robot to identify a grasped object and assess the stability of a grasp, among other things. However, the tactile sensor must come into contact with the target object in order to produce readings. As a result, tactile data can only be attained if a real contact is made. We propose to overcome this restriction by employing a method that models the behaviour of a tactile sensor using 3D vision and grasp information as a stimulus. Our system regresses the quantified tactile response that would be experienced if this grasp were performed on the object. We experiment with 16 items and 4 tactile data modalities to show that our proposal learns this task with low error.

Paper at IEEE

November 15, 2020

J. F. Gómez, J. M. Gutiérrez, J. Arregui and M. D. Fabregat from INESCOP published the article "Footwear assembly by robots" within the topic of "manufacturing and materials innovation" in journal World footwear, in issue four, volume 14, 2020.

November 19, 2020

Live session at workshop ROMADO

Today we have successfully celebrated the online live session of the workshop on Robotic Manipulation of Deformable Objects (ROMADO). This workshop is organized in conjunction with the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2020). The

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number of attendees to the online session was more than forty people. We thank all the attendees for their participation and especially to the guest speakers for their involvement in the success of this workshop.

November 22, 2020

Best presentation at ICRAE 2020

Ignacio Cuiral-Zueco presented the work “Dynamic occlusion handling for real time object perception” at the 5th International Conference on Robotics and Automation Engineering
(ICRAE 2020). His oral presentation was awarded as the best one of the session “Robot Design and Development”.

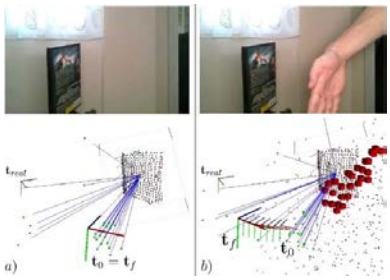
November 23, 2020

Paper: Dynamic occlusion handling for real time object perception

Authors: Ignacio Cuiral-Zueco and Gonzalo Lopez-Nicolas

Conference: International Conference on Robotics and Automation Engineering

(ICRAE 2020), November 20-22, 2020



Abstract: An RGB-D based occlusion-handling camera position computation method for proper object perception has been designed and implemented. This proposal is an improved alternative to our previous optimisation-based approach where the contribution is twofold: this new method is geometric-based and it is also able to handle dynamic occlusions. This approach makes extensive use of a ray-projection model where a key aspect is that the solution space is defined within a sphere surface around the object. The method has been designed with a view to robotic applications and therefore provides robust and versatile features. Therefore, it does not require training nor prior knowledge of the scene, making it suitable for diverse applications and scenarios. Satisfactory results have been obtained with real time experiments.

Conference website

November 30, 2020

Paper: Distributed relative localization using the multi-dimensional weighted centroid

Author: R. Aragüés, A. González, G. López-Nicolás, C. Sagüés.

Journal: IEEE Transactions on Control of Network Systems, vol. 7, pp. 1272-1282, 2020.

Abstract: A key problem in multi-agent systems is the distributed estimation of the localization of agents in a common reference from relative measurements. Estimations can be referred to an anchor node or, as we do here, referred to the weighted centroid of the multi-agent system. We propose a Jacobi Over–Relaxation method for distributed estimation of the weighted centroid of the multi-agent system from noisy relative measurements. Contrary to previous approaches, we consider relative multi-dimensional measurements with general covariance matrices not necessarily fully diagonal. We analyze the method convergence and provide mathematical

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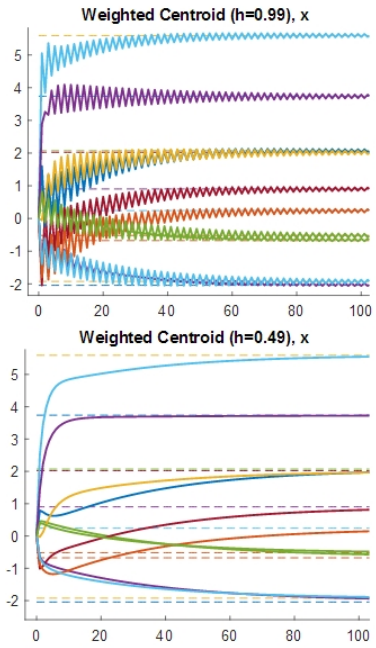
constraints that ensure avoiding ringing phenomena. We also prove our weighted centroid method converges faster than anchor-based solutions.



Example with 10 agents in a chain graph. Evolution along iterations of the estimated x-coordinate relative to the weighted centroid of the team. Top: The ringing oscillatory behavior can be observed for h = 0.99. At each step, the estimates change their values sharply. Bottom: The ringing oscillatory behavior is removed with h = 0.49. The estimates converge nowsmoothly.

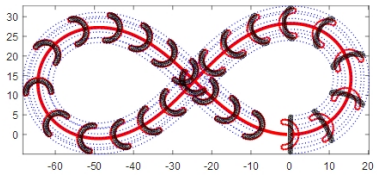
Download paper

December 1, 2020

Paper: Simultaneous shape control and transport with multiple robots

Author: G. López-Nicolás, R. Herguedas, M. Aranda, Y. Mezouar.

Conference: IEEE International Conference on Robotic Computing (IRC), pp. 218-225, 2020.



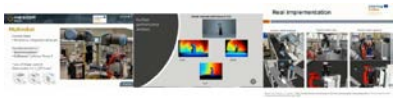
Abstract: Autonomous transport of objects may require multiple robots when the object is large or heavy. Besides, in the case of deformable objects, a set of robots may also be needed to maintain or adapt the shape of the object to the task requirements. The task we address consists in transporting an object, represented as a two dimensional shape or contour, along a desired path. Simultaneously, the team of robots grasping the object is controlled to the desired contour points configuration. Since the mobile robots of the team obey nonholonomic motion constraints, admissible trajectories are designed to keep the integrity of the object while following the prescribed path. Additionally, the simultaneous control of the object's shape is smoothly performed to respect the admissible deformation of the object. The main contribution lies in the definition of the grasping robots' trajectories dealing with the involved constraints. Different simulations, where the deformable object dynamics are modelled with consensus-based techniques, illustrate the performance of the approach.

Download paper
Video

December 16, 2020

COMMANDIA virtual meeting

The partners of the project presented their advances in the meeting of the COMMANDIA consortium in a virtual meeting on December 16, 2020.



December 17, 2020

BiTS D INNOVATION

The BiTS D INNOVATION is a dissemination conference, organized by INESCOP on 17th December 2020, with the objective

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

of bringing some of the results and technological advances obtained in 2020 closer to the footwear sector, through R+D+I activities.

"Pieces" of innovation on "Sustainability", "Comfort and Health" and "Advanced Manufacturing", in an entertaining and very demonstrative format.

In the area of Advanced Manufacturing, Jose Maria Gutierrez from INESCOP presented the talk "Multi-robot manipulation for the cut-floor joint operation".

At COMMANDIA, INESCOP works together with 4 European universities, in the automation of the joining operation between the shoe cut, and a deformable object such as the floor. The manipulation of deformable objects is one of the main current challenges of robotization.

This union operation takes place after the adhesive has been applied on the floor, and consists of collecting the sole of a tape with a robot, and with the help of a second robot, run accurately on a cut that is prefixed. For this union, we have a 3D vision system that will tell us at all times the relative position between the elements and the necessary actions of the robots to proceed properly. The use of two robots allows us to correctly handle the floor even though it is flexible, and to be able to use this factor in our favor if necessary.

December 18, 2020

Autonomous navigation of mobile manipulator robot with camera and laser in the ROS environment

Student degree project at UNIZAR on December 2020 in the framework of COMMANDIA: "Autonomous navigation of mobile manipulator robot with camera and laser in the ROS environment" by David Barrera.

In this work we have used the environment ROS (Robot Operating System) to develop the autonomous navigation of a mobile manipulator robot. The navigation has been carried out in simulation and in real environments. The mobile platform is a robot known as robot Campero, that it is a prototype of the commercial robot RB-EKEN (Robotnik). The sensors used for the navigation are laser and vision. We have developed several programs for different types of navigation and the experiment results have been analyzed.

December 25, 2020

Paper: RGB-D Sensing of Challenging Deformable Objects

Authors: Ignacio Cuiral-Zueco and Gonzalo Lopez-Nicolas

Workshop: Workshop on Managing deformation: A step towards higher robot autonomy (MaDef), 25 October – 25 December, 2020

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

Collaborative Robotic Mobile Manipulation of Deformable Objects in Industrial Applications

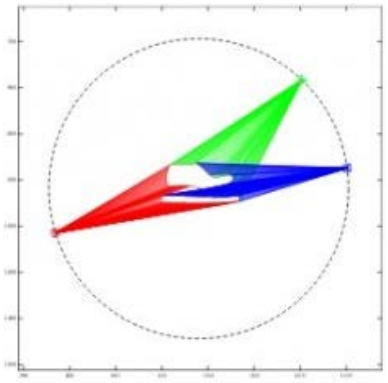
Abstract: The problem of deformable object tracking is prominent in recent robot shape-manipulation research. Additionally, texture-less objects that undergo large deformations and movements lead to difficult scenarios. Three RGB-D sequences of different challenging scenarios are processed in order to evaluate the robustness and versatility of a deformable object tracking method. Everyday objects of different complex characteristics are manipulated and tracked. The tracking system, pushed out the comfort zone, performs satisfactorily.

Webpage

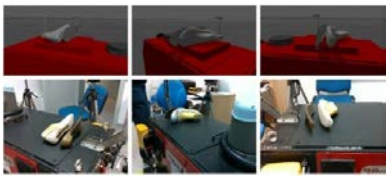
December 25, 2020

Paper: Experimental multi-camera setup for perception of dynamic objects

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



Workshop: Robotic Manipulation of Deformable Objects (ROMADO), 25 October – 25 December, 2020



Abstract: Currently, perception and manipulation of dynamic objects represent an open research problem. In this paper, we show a proof of concept of a multi-camera robotic setup which is intended to perform coverage of dynamic objects. The system includes a set of RGB-D cameras, which are positioned and oriented to cover the object's contour as required in terms of visibility. An algorithm of a previous study allows us to minimize and configure the cameras so that collisions and occlusions are avoided. We test the validity of the platform with the Robot Operating System (ROS) in simulations with the software Gazebo and in real experiments with Intel RealSense modules.

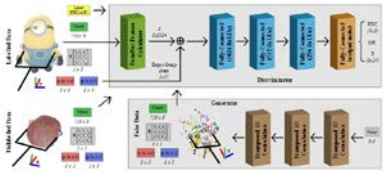
Download paper

December 25, 2020

Paper: Prediction of tactile perception from vision on deformable objects

Authors: Brayan S. Zapata-Impata and Pablo Gil

Workshop: Robotic Manipulation of Deformable Objects (ROMADO), 25 October – 25 December, 2020



Abstract: Through the use of tactile perception, a manipulator can estimate the stability of its grip, among others. However, tactile sensors are only activated upon contact. In contrast, humans can estimate the feeling of touching an object from its visual appearance. Providing robots with this ability to generate tactile perception from vision is desirable to achieve autonomy. To accomplish this, we propose using a Generative Adversarial

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Network. Our system learns to generate tactile responses using as stimulus a visual representation of the object and target grasping data. Since collecting labeled samples of robotic tactile responses consumes hardware resources and time, we apply semi-supervised techniques. For this work, we collected 4000 samples with 4 deformable items and experiment with 4 tactile modalities.

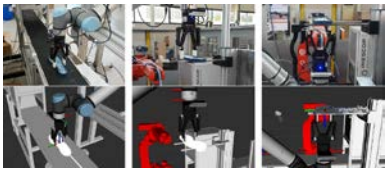
Download paper

March 31, 2021

Paper: Towards footwear manufacturing 4.0: shoe sole robotic grasping in assembling operations

Autor: Guillermo Oliver, Pablo Gil, Jose F. Gomez, Fernando Torres

Journal: The International Journal of Advanced Manufacturing Technology, 2021



Abstract: In this paper, we present a robotic workcell for task automation in footwear manufacturing such as sole digitization, glue dispensing, and sole manipulation from different places within the factory plant. We aim to make progress towards shoe industry 4.0. To achieve it, we have implemented a novel sole grasping method, compatible with soles of different shapes, sizes, and materials, by exploiting the particular characteristics of these objects. Our proposal is able to work well with low density point clouds from a single RGBD camera and also with dense point clouds obtained from a laser scanner digitizer. The method computes antipodal grasping points from visual data in both cases and it does not require a previous recognition of sole. It relies on sole contour extraction using concave hulls and measuring the curvature on contour areas. Our method was tested both in a simulated environment and in real conditions of manufacturing at INESCOP facilities, processing 20 soles with different sizes and characteristics. Grasps were performed in two different configurations, obtaining an average score of 97.5% of successful real grasps for soles without heel made with materials of low or medium flexibility. In both cases, the grasping method was tested without carrying out tactile control throughout the task.

Paper at Springer

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