COMMANDIA NEWSLETTER

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Collaborative Robotic Mobile Manipulation of Deformable Objects in Industrial Applications

April 6, 2019

Meeting at Coimbra

Meeting of the COMMANDIA consortium at University of Coimbra on April 5, 2019.

April 13, 2019

Paper: Clasificación de objetos usando percepción bimodal de palpación única en acciones de agarre robótico

Title: Clasificación de objetos usando percepción bimodal de palpación única en acciones de agarre robótico
Author: Edison Velasco, Brayan S. Zapata-Impata, Pablo Gil, Fernando Torres

Journal: Revista Iberoamericana de Automática e Informática industrial, [S.l.], abr. 2019. ISSN 1697-7920. doi:

Abstract: Este trabajo presenta un método para clasificar objetos agarrados con una mano robótica multidedo combinando en un descriptor híbrido datos propioceptivos y táctiles. Los datos propioceptivos se obtienen a partir de las posiciones articulares de la mano y los táctiles del contacto registrado por células de presión en las falanges. La aproximación propuesta permite identificar el objeto, extrayendo de la pose de la mano la geometría de contacto y de los sensores táctiles la estimación de la rigidez y flexibilidad de éste. El método muestra que usar datos bimodales de distinta naturaleza y técnicas de aprendizaje supervisado mejora la tasa de reconocimiento. En la experimentación, se han llevado a cabo más de 3000 agarres de hasta 7 objetos domésticos distintos, obteniendo clasificaciones correctas del 95% con métrica F1, sin necesidad de ejecutar múltiples palpaciones del objeto. Además, la generalización del método se ha verificado entrenando nuestro sistema con ciertos objetos y clasificando otros nuevos sin conocimiento previo alguno de estos.
Download paper

May 13, 2019

Paper: Framework for Fast Experimental Testing of Autonomous Navigation Algorithms

Title: Framework for Fast Experimental Testing of Autonomous Navigation Algorithms
Author: Muñoz–Bañón MÁ, del Pino I, Candelas FA, Torres F.
Framework for Fast Experimental Testing of Autonomous Navigation Algorithms.
Journal: Applied Sciences. 2019; 9(10):1997.
doi:10.3390/app9101997
Abstract: Research in mobile robotics requires fully operative autonomous systems to test and compare algorithms in real-world conditions. However, the implementation of such systems remains to be a highly time-consuming process. In this work, we present a robot operating system (ROS)-based navigation framework that allows the generation of new autonomous navigation applications in a fast and simple way. Our framework provides a powerful basic structure based on abstraction levels that ease the implementation of minimal solutions with all the functionalities required to implement a whole autonomous system. This approach helps to keep the focus in any sub-problem of interest (i.e. localization or control) while permitting to carry

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

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out experimental tests in the context of a complete application. To show the validity of the proposed framework we implement an autonomous navigation system for a ground robot using a localization module that fuses global navigation satellite system (GNSS) positioning and Monte Carlo localization by means of a Kalman filter. Experimental tests are performed in two different outdoor environments, over more than twenty kilometers. All the developed software is available in a GitHub repository.
Download paper

May 25, 2019

IEEE International Conference on Robotics and Automation 2019

Miguel Aranda presented at ICRA2019 the work entitled "Deformation-Based Shape Control with a Multirobot System", which was coauthored by Juan Antonio Corrales and Youcef Mezouar. The conference was held on May 20-24, 2019 Montreal, Canada.

Abstract: We present a novel method to control the relative positions of the members of a robotic team. The application scenario we consider is the cooperative manipulation of a deformable object in 2D space. A typical goal in this kind of scenario is to minimize the deformation of the object with respect to a desired state. Our contribution, then, is to use a global measure of deformation directly in the feedback loop. In particular, the robot motions are based on the descent along the gradient of a metric that expresses the difference between the team's current configuration and its desired shape. Crucially, the resulting multirobot controller has a simple expression and is inexpensive to compute, and the approach lends itself to analysis of both the transient and asymptotic dynamics of the system. This analysis reveals a number of properties that are interesting for a manipulation task: fundamental geometric parameters of the team (size, orientation, centroid, and distances between robots) can be suitably steered or bounded. We describe different policies within the proposed deformation-based control framework that produce useful team behaviors. We illustrate the methodology with computer simulations.
Download paper

June 1, 2019

Mobile manipulator at COMMANDIA

Let us introduce our mobile robotic platform Campero. This is a mobile manipulator prototype developed in the framework of project COMMANDIA. The main goal is the definition, design and implementation of integrated functionalities in robotic platforms that extend the capabilities of robotic systems for the manipulation of deformable objects in the context of industrial production. With this platform, we will provide a laboratory prototype of a multi-sensorial multi-robot with manipulation and ground locomotion capabilities, increasing precision in complex autonomous manipulation tasks of deformable objects.

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

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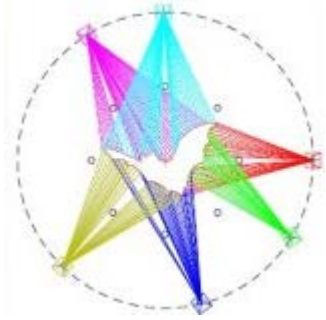
June 7, 2019

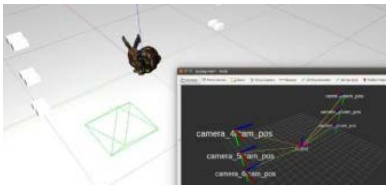
I3A Young Researchers Conference

We presented three different works of COMMANDIA in the "Jornada de Jóvenes Investigadores del I3A", which were held on June 6 2019 in Zaragoza, Spain:

-R. Herguedas, G. López-Nicolás, C. Sagüés. Minimal multi-camera system for perception of deformable shapes. (Link)
-J. Martínez-Cesteros, G. López-Nicolás. Automatic image dataset generation for footwear detection. (Link)
-E. Hernández-Murillo, R. Aragüés, G. López-Nicolás. Volumetric object reconstruction in multi-camera scenarios. (Link)

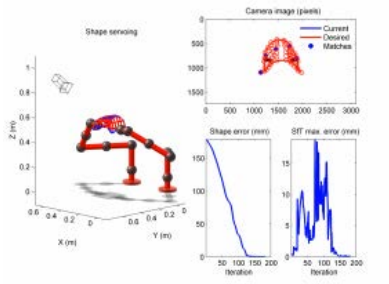


The journal "Jornada de Jóvenes Investigadores del I3A" (ISSN:2341-4790) collects the proceedings of the conferences that are held annually since 2012 at the Instituto Universitario de Investigación en Ingeniería de Aragón (I3A), belonging to the University of Zaragoza. These conferences are the meeting point for researchers starting their research career at the I3A.

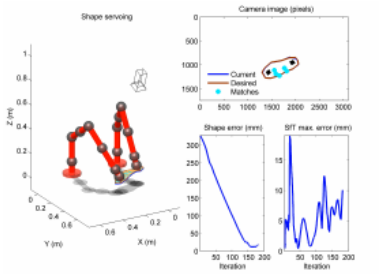


June 12, 2019

Videos: Simulations of manipulation of deformable objects from monocular vision



Manipulation of a sheet



Manipulation of a sole

June 23, 2019

Paper: Vision2tactile: feeling touch by sight

Title: Vision2tactile: feeling touch by sight
Author: B.S. Zapata-Impata, P. Gil, F. Torres
Conference: Robotics Science and Systems (RSS): Workshop on Closing the Reality Gap in Sim2real Transfer for Robotic Manipulation, June 23, 2019
Abstract: Latest trends in robotic grasping combine vision and touch for improving the performance of systems at tasks like stability prediction. However, tactile data are only available during the grasp, limiting the set of scenarios in which multimodal solutions can be applied. Could we obtain it prior to grasping? We explore the use of visual perception as a stimulus for generating tactile data so the robotic system can 'feel' the response of the tactile perception just by looking at the object.
Download paper

June 26, 2019

COMMANDIA Tutorial on ROS

The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications. And it's all open source. This is the platform chosen for developing COMMANDIA Project. On June 25, 2019 a tutorial

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on ROS was successfully held on SIGMA Clermont with simultaneous streaming to University of Coimbra, University of Zaragoza, INESCOP and University of Alicante.

July 1, 2019

Paper: TactileGCN: A graph convolutional network for predicting grasp stability with tactile sensors

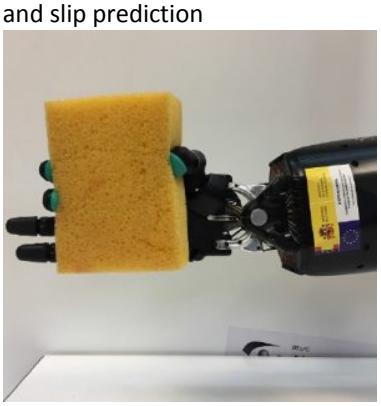
Title: TactileGCN: A graph convolutional network for predicting grasp stability with tactile sensors

Author: A. Garcia-Garcia, B.S. Zapata-Impata, S. Orts-Escolano, P. Gil, J. García
Conference: International Joint Conference on Neural Netwoks (IJCNN), 14-19 July 2019

Abstract: Tactile sensors provide useful contact data during the interaction with an object which can be used to accurately learn to determine the stability of a grasp. Most of the works in the literature represented tactile readings as plain feature vectors or matrix-like tactile images, using them to train machine learning models. In this work, we explore an alternative way of exploiting tactile information to predict grasp stability by leveraging graph-like representations of tactile data, which preserve the actual spatial arrangement of the sensor's taxels and their locality. In experimentation, we trained a Graph Neural Network to binary classify grasps as stable or slippery ones. To train such network and prove its predictive capabilities for the problem at hand, we captured a novel dataset of ~ 5000 three-fingered grasps across 41 objects for training and 1000 grasps with 10 unknown objects for testing. Our experiments prove that this novel approach can be effectively used to predict grasp stability.
Download paper

August 1, 2019

Paper: Tactile-driven grasp stability and slip prediction



Title: Tactile-driven grasp stability and slip prediction
Author: B. S Zapata-Impata, P. Gil, F. Torres
Journal: Robotics 2019, 8, 85.
Abstract: One of the challenges in robotic grasping tasks is the problem of detecting whether a grip is stable or not. The lack of stability during a manipulation operation usually causes the slippage of the grasped object due to poor contact forces. Frequently, an unstable grip can be caused by an inadequate pose of the robotic hand or by insufficient contact pressure, or both. The use of tactile data is essential to check such conditions and, therefore, predict the stability of a grasp. In this work, we present and compare different methodologies based on deep learning in order to represent and process tactile data for both stability and slip prediction.
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August 26, 2019

Paper: Multi-camera coverage of deformable contour shapes

Title: Multi-camera coverage of deformable contour shapes
Authors: Rafael Herguedas , Gonzalo López-Nicolás and Carlos Sagüés.
Conference: IEEE International Conference on Automation Science and Engineering (CASE 2019), August 22-26, 2019, Vancouver, BC, Canada.
Abstract: Perception of deformation is a key problem when dealing with autonomous manipulation of deformable objects. Particularly, this work is motivated by tasks where the manipulated object follows a prescribed known deformation with the goal of performing a desired coverage of the object's contour along its deformation. The main contribution is a simple yet effective novel perception system in which a team of robots equipped with limited field-of-view cameras covers the object's contour according to a prescribed visibility objective. In order to define a feasible visibility objective, we propose a new method for obtaining the maximum achievable visibility of a contour from a circumference around its centroid. Then, we define a constrained optimization problem and we solve it iteratively to compute the minimum number of cameras and their near optimal positions around the object that guarantee the visibility objective, over the entire deformation process.
Download paper

September 14, 2019

Paper: Survey on multi-robot manipulation of deformable objects

Title: Survey on multi-robot manipulation of deformable objects
Authors: Rafael Herguedas, Gonzalo López-Nicolás, Rosario Aragüés and Carlos Sagüés.
Conference: IEEE International Conference on Emerging Technologies and Factory Automation (ETFA 2019), September 10-13, 2019, Zaragoza, Spain.
Abstract: Autonomous manipulation of deformable objects is a research topic of increasing interest due to the variety of current processes and applications that include this type of tasks. It is a complex problem that involves aspects such as modeling, control, perception, planning, rasping, estimation, etc. A single robot may be unable to perform the manipulation when the deformable object is too big, too heavy or difficult to grasp. Then, using multiple robots working together naturally arises as a solution to perform coordinately the manipulation task. In this paper, we contribute a survey of relevant state of-the-art approaches concerning manipulation of deformable objects by multiple robots, which includes a specific classification with different criteria and a subsequent analysis of the leading methods, the main challenges and the future research directions.
Download paper

September 14, 2019

Paper: Multi-camera architecture for perception strategies

Title: Multi-camera architecture for perception strategies
Authors: Enrique Hernández, Gonzalo López-Nicolás and Rosario Aragüés.
Conference: IEEE International Conference on Emerging Technologies and Factory Automation (ETFA 2019), September 10-13, 2019, Zaragoza, Spain.
Abstract: Building the 3D model of an object is a complex problem that involves aspects such as modeling, control, perception or planning. Performing this task requires a set of different views to cover the entire surface of the object. Since a single camera takes too long to travel through all these positions, we consider a multi-camera scenario. Due to the camera constraints such as the limited field of view or self-occlusions, it is essential to use an effective configuration strategy to select the appropriate views that

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provide more information of the model. In this paper, we develop a multi-camera architecture built on the Robot Operating System. The advantages of the proposed architecture are illustrated with a formation-based algorithm to compute the view that satisfies these constraints for each robot of the formation to obtain the volumetric reconstruction of the target object.
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