

Curriculum Vitae

Fanny Ficuciello



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Ficuciello Fanny

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Education and training

Dec 2010 Research Doctorate degree in Computer Science and Automation Engineering, XXIII cycle, University of Naples Federico II, Department of Electrical Engineering and Information Technology (DIETI). Ph.D. Thesis title: "Modelling and Control for Soft Finger Manipulation and Human-Robot Interaction". Thesis Supervisor: Prof. Luigi Villani.
Sep 2009-Mar 2010 Visiting scholar in the Control Engineering Group at the University of Twente (Netherlands) under the supervision of Prof. Stefano Stramigioli.
Sep 2007 Laurea degree magna cum laude in Mechanical Engineering at University of Naples Federico II. Thesis title: "Tecniche di controllo di robot leggeri con elasticità ai giunti per una interazione sicura uomo-robot". Supervisor: Prof. Bruno Siciliano.

Actual Position

Research Scientist at University of Naples as member of PRISMA (Projects of Industrial and Service Robotics, Mechatronics and Automation) team headed by Prof. Bruno Siciliano, and as member of ICAROS center (Interdepartmental Center for Advances in Robotic Surgery) of the University of Naples Federico II.

Past Positions

Jun 2014-Sep 2014 Agreement for scientific project executor assigned by C.R.E.A.T.E.(Consorzio di Ricerca per l'Energia e le Applicazioni Tecnologiche dell'Elettromagnetismo) for advisory activity on control of anthropomorphic robot hands within the RoDyMan (ERC AdG- 320992, 2013-2018 <http://www.rodyman.eu>) project.

Jun 2012-May 2014

Research Associate (Post-doc) in the research unit of the Department of Electrical Engineering and Information Technology (DIETI), University of Naples Federico II, with a fellowship in "Controllo della Interazione di robot con giunti elastici passivi e a impedenza variabile" within the SAPHARI "Safe and Autonomous Physical and Human-Aware Robot Interaction" (FP7 ICT-2011-287513, 2011-2015 www.saphari.eu) International European project.

Feb 2009-Dec 2012

Component of the research unit of the Department of Electrical Engineering and Information Technology (DIETI), University of Naples Federico II, within the DEXMART "DEXterous and autonomous dual-arm/hand robotic manipulation with sSMART sensory-motor skills: A bridge from natural to artificial cognition" (FP7-216239, www.dexmart.eu) International European project.

Dec 2007 Sep 2009

Component of the research unit of the Department of Electrical Engineering and Information Technology (DIETI), University of Naples Federico II, within the PHRIENDS "PHRIDOM Physical Human Robot Interaction in anthropic DOMains: safety and dependability" (STReP IST-045359) International European project.

Participation in National and International Projects

Component of the research unit of the Department of Electrical Engineering and Information Technology (DIETI), University of Naples Federico II, within the RoDyMan "Robotic Dynamic Manipulation"(ERC AdG- 320992, 2013-2018 <http://www.rodyman.eu>) project.

Component of the research unit of the Department of Electrical Engineering and Information Technology (DIETI), University of Naples Federico II, within the SAPHARI "Safe and Autonomous Physical and Human-Aware Robot Interaction" (FP7 ICT-2011-287513, 2011-2015 www.saphari.eu) International European project.

Component of the research unit of the Department of Electrical Engineering and Information Technology (DIETI), University of Naples Federico II, within the DEXMART "DEXterous and autonomous dual-arm/hand robotic manipulation with sSMART sensory-motor skills: A bridge from natural to artificial cognition" (FP7-216239, www.dexmart.eu) International European project.

Component of the research unit of the Department of Electrical Engineering and Information Technology (DIETI), University of Naples Federico II, within the PHRIENDS "PHRIDOM Physical Human Robot Interaction in anthropic DOMains: safety and dependability" (STReP IST-045359) International European project.

Research Activities

Fanny Ficuciello research interests include: biomechanical design and bio-aware control strategies for anthropomorphic artificial hands, grasping and manipulation with hand/arm and dual hand/arm robotic systems, human-robot interaction control, variable impedance control and redundancy resolution strategies. Recently she is involved also on surgical robotics research projects, as a member of the ICAROS center (Interdepartmental Center for Advances in Robotic Surgery) of the University of Naples Federico II. During the research activity Fanny Ficuciello has developed planning and control strategies based on postural synergies and supervised learning and reinforcement learning techniques for anthropomorphic hands; impedance based control strategies for hand-arm and dual hand-arm systems and intentional-aware human-robot interaction. She has established several partnerships on the different research topics.

Major Scientific Collaboration
2014

Collaboration on "*Human-Robot Physical Interaction*" with Prof. Ciro Natale, Department of Industrial and Information Engineering (DIII) Second University of Naples, within the DEXMART (FP7-216239, www.dexmart.eu). Related publications: [UR-1].

2011-2014

Collaboration on "*Postural Synergies*" with Prof. Gianluca Palli, Prof. Cladio Melchiorri, Automation and Robotics Lab (LAR-DEI), Department of Electrical Engineering and Information Technology, University of Bologna, within the DEXMART (FP7-216239, www.dexmart.eu) International European project. Related publications: [IJ-1], [IJ-2], [BC-1]-[BC-3], [IC-2]-[IC-4], [IC-7]-[IC-9].

- 2010 Collaboration on "*Port-Hamiltonian Modeling*" with Prof. Stefano Stramigioli, Control Engineering Group at the University of Twente (Netherlands), within the DEXMART (FP7-216239, www.dexmart.eu). Related publications: [IC-1].
- 2008 Collaboration on "*Haptic simulator for rehabilitation*" with Prof. S. Di Martino, Department of Physical Science, University of Naples Federico II, within the DEXMART (FP7-216239, www.dexmart.eu) International European project. Related publications: [NC-1].

Main research contributions

Control of a complex hand-arm robotic system during grasping

The results obtained by Fanny Ficuciello during her research activity, published in journals and proceedings of the robotic international community, are here resumed.

The problem of controlling a complex hand-arm robotic system during grasping tasks has been addressed in [IC-5]. Such a system can interact with the environment or with a human being, for example during the exchange of an object. The applied control is in charge of ensuring that the hand firmly grasps the object and that the arm is compliant with respect to external forces applied to the grasped object. Relying on grasping theory, the reconstruction of the external forces applied to the object by means of the force measurements at the fingertips is used in the control action. Force measurements are also used to ensure the adjustment of the internal forces exerted on the object to have a stable grasp during the interaction with the environment.

Control of two arms robotic system during grasping

With regards to safe human-robot interaction control, an algorithm, that enhances safety and reliability, based on the impedance control of a two arms system that grasps an object and interacts with the environment, has been developed in [IC-6]. To obtain a safe behavior of the system during the intentional interaction with the object and unintentional interaction on the body, a compliant behavior of the entire system is ensured by applying an impedance control at three levels, i.e. object, end-effector and body level. A centralized impedance control strategy is provided to confer a compliant behavior to the object, while an active decentralized impedance with force tracking control is enforced to the end-effectors to control internal forces on the object. Furthermore, a compliant behavior on the body of the dual-arm system is obtained by means of null-space impedance control while the manipulability measure of the whole system is locally maximized.

Control of anthropomorphic hands

Fanny Ficuciello has developed techniques of planning and control based on the notion of postural synergies and neural networks inspired by neuroscience studies carried out on human hand and the functioning of the human brain. In [IJ-1, IC-2, IC-3, IC-4], different techniques to obtain the synergies subspace of an anthropomorphic robotic hand, using the human hand as a guide, have been tested and compared. In [IJ-2, IC-7, IC-8], a set of grasping postures performed by five subjects in grasping commonly used objects has been mapped to a robotic hand assuming its own kinematics as a simplified model of the human hand. Using an RGB camera and depth sensor for 3D motion capture, the human hand palm pose and fingertip positions have been measured for the reference set of grasps. In [BC-3] a neural network model has been designed for planning grasps of a cybernetic hand prototype by means of postural synergies. In [IC-9], the problem of in-hand dexterous manipulation has been addressed on the base of postural synergies analysis.

Port-Hamiltonian Modeling for Soft Manipulation

In [IC-1], the theory of port-Hamiltonian systems has been explored to model a multi-fingered robotic hand, with soft-pads, while grasping and manipulating an object. The theory of port-Hamiltonian systems allows to describe the system behavior in a coordinate-free way and can be naturally extended to include constrained systems and compliant contact models. The viscoelastic behavior of the contact is described in terms of energy storage and dissipation. Using the concept of power ports, the dynamics of the hand, the contact, and the object are described in a coordinate-free way. Moreover, an IPC is applied to control the motion of the object and to regulate the internal forces. The main advantage of the port-Hamiltonian formulation for constrained systems is that we do not need to modify the dynamic equations when a change occurs in the contact state. Instead, it is possible to represent both cases in a time-dependent geometrical structure, that satisfies the power continuity conditions in every contact state. This framework allows to approach the problem in a more intuitive and compact way.

Underactuated hands require the investigation of planning and control methods that disregard accurate definition of the desired contact points on the object and guarantee robustness with respect to variability of shape and size. To overcome these problems, Fanny Ficuciello has developed control and learning algorithms that rely on the synergies concept. The contribution is divided in three parts concerning synergies computation, control and learning. Those parts are different aspects of the same research that goes towards the realization of human-like prehensile capabilities and autonomous learning skills for a robotic upper limb system with anthropomorphic design. In [IC-13], the same data set of grasps, measured on five human subjects and available from [IC-8], is used to evaluate the grasping capabilities of an underactuated robot hand in a synergy-based framework. Once the synergy matrix of an underactuated hand has been computed, in order to test the efficiency of the mapping method, different grasps can be reproduced in the three dimensions synergies subspace. Actually, since mechanical synergies of the underactuated hand affect the mapping from the human hand, the projection of a grasp from the data set in the synergies subspace is not so effective as for the full-actuated anthropomorphic hands. This means that a control strategy is required to adjust the reference grasp in order to let the hand adapting to the object while moving in the synergies subspace. The synergies subspace has been tested for the hand control using a kinematic algorithm based on has been adopted. The fingertips desired positions are modified in the control algorithm in order to reduce their distance with respect to the centroid of a virtual object computed as the centroid of the fingertips involved in the desired grasp. Moreover, in order to limit the grasping forces, the desired target is further modified on the basis of the measured motor current and of a defined threshold that is related to the texture of the object. The experiments demonstrate that the synergies subspace is suitable for hand control in grasping a wide variety of objects, i.e. the algorithm is stable and effectively regulates the grasping forces by modifying the motor positions in the synergies subspace. Moreover, to improve the grasping capabilities strategies based on quality indexes to close the hand toward the object in the synergies subspace have been developed in [R-2]. Model-based control strategies relying on synergistic models of manipulation activities learned from human experience can be integrated with real-time learning from actions strategies. The use of supervised learning, such as artificial neural networks, or reinforcement learning techniques, serves for the parameterization of synergies depending on task requirements. Fanny Ficuciello has developed Supervised Learning (SL) and Reinforcement Learning (RL) strategies. In [C-18] a supervised learning strategy has been applied in conjunction with a control strategy to provide anthropomorphic hand-arm systems with autonomous grasping capabilities. Both learning and control algorithms have been developed in a synergy-based framework in order to address issues related to high dimension of the configuration space, that typically characterizes robotic hands and arms with human-like kinematics. An experimental setup has been built to learn hand-arm motion from humans during reaching and grasping tasks. Then, a Neural Network (NN) has been realized to generalize the grasps learned by imitation. Since the NN approximates the relationship between the object characteristics and the grasp configuration of the hand-arm system, a synergy-based control strategy has been applied to overcome planning errors. In [C-17] is demonstrated that a synergy based approach is powerful for reinforcement learning of grasping with anthropomorphic hands due to configuration space dimensionality reduction that guarantees the convergence and efficiency of the learning algorithm. The design of appropriate policy representations is essential for RL methods to be successfully applied to real-world robots. PCA and human grasps data set serve as data structures to define a policy and its initial parameters for a RL algorithm. Indeed, starting from a good enough demonstration, the algorithm can optimize the policy parameters to gradually refine a stable grasp. When a clear measure about the success of the task is available, RL adaptability to new objects is ensured. A key point is the adoption of a suitable reward function representing the goal of the task and ensuring one-step performance evaluation.

Impedance control strategies
with redundancy resolution for
human-robot intuitive
co-manipulation

Surgery simulators with realistic
haptic rendering

The control of safe and efficient physical interaction between a human and the robot co-worker has been addressed in [IC-10, BC-4] by investigating new and efficient approach to redundancy resolution and variable impedance control strategies. Redundancy has been exploited to make the robot equivalent inertia at the end-effector as close as possible to the desired inertia. In particular, since co-manipulation tasks typically require a decoupled impedance along the Cartesian directions, the redundant degrees of freedom are used to reduce as much as possible the dynamic coupling of the end-effector equivalent inertia. In [IJ-3, IJ-5, IC-11], a study on variable impedance control for a redundant robot arm to enable an intuitive and safe physical interaction with humans during the execution of co-manipulation tasks has been proposed. The impedance parameters are modulated on-line according to the human behaviour during the interaction.

Recently, the research activities of Fanny Ficuciello have been extended also to surgical robotics. In [IC-14] a soft-rigid collision algorithm has been integrated in an open source physics engine, Bullet Physics. In surgical applications this can be the case of a clamp grabbing deformable organic materials or of a spatula opening a brain fissure. The default soft-rigid collision algorithm proposed in Bullet is not very effective in the case of thin tools interacting with deformable objects. In particular, if the rigid body (surgical tool) moves slowly, i.e. its displacement covers a small distance compared to the simulation step size, the collision is detected regularly, otherwise the default algorithm does not recognize the collision. As a consequence, the object penetrates into the soft body. Besides the implementation of the soft-rigid collision algorithm, the new contribution consists on generalizing the algorithm to different shaped rigid object such as convex rigid bodies with thin thickness along one of the three main directions. Moreover, the haptic rendering has been realized by controlling the spatula in the 3D virtual space with the Novint Falcon 3D Haptic Controller. The default linear elastic model of the interaction force has been replaced with a more realistic and physical consistent non-linear viscoelastic model. As a second step, the algorithm has been further extended to a clamp constituted by two rigid colliding objects grabbing deformable materials.

Publications

International journal papers (refereed)

[IJ-6]

F. Ficuciello, B. Siciliano, "Learning in robotic manipulation: The role of dimensionality reduction in policy search methods. Comment on Hand synergies: Integration of robotics and neuroscience for understanding the control of biological and artificial hands by Marco Santello, Matteo Bianchi, Marco Gabiccini, Emiliano Ricciardi, Gionata Salvietti et al.", *Physics of Life Reviews*, 17:36-37 2016, doi: 10.1016/j.plrev.2016.04.002.

[IJ-5]

F. Ficuciello, L. Villani, B. Siciliano, "Impedance Control of Redundant Manipulators for Safe Human-Robot Collaboration", *Acta Polytechnica Hungarica, Journal of Applied Science, Special Issue on Recent Advances in Robotics - In Memoriam Antal K. Bejczy* Guest Editors: Imre J. Rudas, Tamás Haidegger, 13(1):223-238, 2016, doi: 10.12700/APH.13.1.2016.1.15.

[IJ-4]

A. Cirillo, **F. Ficuciello**, C. Natale, S. Pirozzi, L. Villani, "A Conformable Force/Tactile Skin for Physical Human-Robot Interaction", *IEEE ROBOTICS AND AUTOMATION LETTERS*, 1(1):41-48, 2015, doi: 10.1109/LRA.2015.2505061.

[IJ-3]

F. Ficuciello, L. Villani, B. Siciliano, "Variable Impedance Control of Redundant Manipulators for Intuitive Human-Robot Physical Interaction", *IEEE Transactions on Robotics*, 31(4):850-863, 2015, doi: 10.1109/TRO.2015.2430053.

[IJ-2]

G. Palli, C. Melchiorri, G. Vassura, U. Scarcia, L. Moriello, G. Berselli, A. Cavallo, G. De Maria, C. Natale, S. Pirozzi, C. May, **F. Ficuciello**, B. Siciliano, "The DEXMART Hand: Mechatronic Design and Experimental Evaluation of Synergy-based Control for Human-like Grasping", *The International Journal of Robotics Research*, 33(5):799-824, 2014, doi: 10.1177/0278364913519897.

[IJ-1]

F. Ficuciello, G. Palli, C. Melchiorri, B. Siciliano, "Postural Synergies of the UB Hand IV for Human-like Grasping", *Robotics and Autonomous Systems*, 62(4): 515-527, 2014, doi: 10.1016/j.robot.2013.12.008.

Book chapters (refereed)

- [BC-5] **F. Ficuciello**, L. Villani, B. Siciliano "Redundancy Resolution in HumanRobot Co-Manipulation with Cartesian Impedance Control", *Springer Tracts in Advanced Robotics (STAR), Experimental Robotics*, M. A. Hsieh, O. Khatib, V. Kumar (Eds.), Springer, no.109, pp. 165-176, 2015, doi: 10.1007/978-3-319-23778-7_12.
- [BC-4] **F. Ficuciello**, A. Romano, V. Lippiello, L. Villani, B. Siciliano "Human Motion Mapping to a Robot Arm with Redundancy Resolution", 14th International Symposium on Advances in Robot Kinematics, Ljubljana (Slovenia), June 29–July 3, 2014 in *Lat-est Advances in Robot Kinematics*, J. Lenarcic and O. Kathib (Eds.), Springer, pp. 193–201, 2014, doi: 10.1007/978-3-319-06698-1_21.
- [BC-3] **F. Ficuciello**, G. Palli, C. Melchiorri, B. Siciliano, "Postural Synergies and Neural Network for Autonomous Grasping: a Tool for Dextrous Prosthetic and Robotic Hands", *Converging Clinical and Engineering Research on Neurorehabilitation, Biosystems & Biorobotics*, J.Pons et al. (Eds.), Springer Berlin Heidelberg, no. 1, pp. 467-480, 2013, doi 10.1007/978-3-642-34546-3_76.
- [BC-2] **F. Ficuciello**, G. Palli, C. Melchiorri, B. Siciliano, "Mapping Grasps from the Human Hand to the DEXMART Hand by means of Postural Synergies and Vision", *Springer Tracts in Advanced Robotics (STAR), Experimental Robotics*, O. Khatib, V. Kumar, G. Sukhatme (Eds.), Springer, no.88, pp. 515-529, 2013, doi: 10.1007/978-3-319-00065-7_35.
- [BC-1] L. Villani, **F. Ficuciello**, V. Lippiello, G. Palli, F. Ruggiero, B. Siciliano, "Grasping and Control of Multifingered Hands", *Springer Tracts in Advanced Robotics (STAR), Ad-advanced bimanual manipulation*, B. Siciliano (Eds.), Springer, vol. 80, pp. 219-266, 2012, doi: 10.1007/978-3-642-29041-1_5.
- International conference papers (refereed)**
- [IC-18] **F. Ficuciello**, D. Zaccara, B. Siciliano, *Learning Grasps in a Synergy-based Frame-work*, 15th International Symposium on Experimental Robotics, Tokyo, Japan, 3-6 October, 2016, to appear.
- [IC-17] **F. Ficuciello**, D. Zaccara, B. Siciliano, *Synergy-based Policy Improvement with Path Integrals for Anthropomorphic Hands*, IEEE/RSJ International Conference on Intelli-gent Robots and Systems, Daejeon, Korea, 9–14 September, 2016, to appear.
- [IC-16] F. Fazioli, **F. Ficuciello**, G.A. Fontanelli, B. Siciliano, L. Villani, *Collision Algorithm for a Clamp Grabbing Deformable Materials: Implementation in an Open-Source Engine*, 9th International Workshop on "Human-Friendly Robotics" (HFR), Genova, Italy, 29-30 October, 2016, to appear.
- [IC-15] **F. Ficuciello**, D. Zaccara, B. Siciliano, *Learning Strategies for Anthropomorphic Hands in a Synergy-based Framework*, 9th International Workshop on "Human-Friendly Robotics" (HFR), Genova, Italy, 29-30 October, 2016, to appear.
- [IC-14] F. Fazioli, **F. Ficuciello**, G.A. Fontanelli, B. Siciliano, L. Villani, *Implementation of a soft-rigid collision algorithm in an open-source engine for surgery realistic simula-tion*, 6th Joint Workshop on New Technologies for Computer/Robot Assisted Surgery (CRAS), Pisa, Italy, 12-14 September, 2016, to appear.
- [IC-13] **F. Ficuciello**, A. Federico, V. Lippiello, B. Siciliano, *Synergies Evaluation of the SCHUNK S5FH for Grasping Control*, 15th International Symposium on Advances in Robot Kinematics, Grasse (France), June 29–July 3, 2016.
- [IC-12] **F. Ficuciello**, D. Zaccara, L. Villani, B. Siciliano, *Experimental Test of Synergies Com-puted on the SCHUNK S5FH under-actuated Hand*, 8th International Workshop on "Human-Friendly Robotics" (HFR), Munich, Germany, 21-23 October, 2015.
- [IC-11] **F. Ficuciello**, L. Villani, B. Siciliano, *The Role of Impedance Modulation and Re-dundancy Resolution in Human-Robot Interaction*, IEEE International Conference on Robotics and Automation, Workshop on "Compliant and Versatile Robot Control in Human Environments: Bridging the Gap between Learning and Control", Seattle, Washington, 26-30 May, 2015.
- [IC-10] **F. Ficuciello**, A. Romano, L. Villani, B. Siciliano, *Cartesian Impedance Control of Redundant Manipulators for Human-Robot Co-Manipulation*, IEEE/RSJ International Conference on Intelligent Robots and Systems, Chicago, Illinois, 14–18 September, 2014, pp. 2120-2125, doi: 10.1109/IROS.2014.6942847.
- [IC-9] G. Palli, **F. Ficuciello**, U. Scarcia, C. Melchiorri, B. Siciliano, *Experimental Evaluation of Synergy-Based In-Hand Manipulation*, IFAC World Congress, Cape Town, South Africa, 24-29 August, 2014, pp. 299-304, doi: 10.3182/20140824-6-ZA-1003.00784.

- [IC-8] **F. Ficuciello**, G. Palli, C. Melchiorri, B. Siciliano. *A Model-based Strategy for Mapping Human Grasps to Robotic Hands Using Synergies*, IEEE/ASME International Conference on Advanced Intelligent Mechatronics, Wollongong, Australia, 9-12 July, 2013, pp. 1737-1742, doi: 10.1109/AIM.2013.6584348.
- [IC-7] **F. Ficuciello**, G. Palli, C. Melchiorri, B. Siciliano, *A model-based strategy for transferring human hand synergies: Experimental validation on the DEXMART hand*, IEEE International Conference on Robotics and Automation, Workshop on Hand Synergies — How to Tame the Complexity of Grasping, Karlsruhe, Germany, 6-10 May, 2013.
- [IC-6] H. Sadeghian, **F. Ficuciello**, L. Villani, M. Keshmiri, *Global Impedance Control of Dual-Arm Manipulation for safe Human-Robot Interaction*, 10th International IFAC Symposium on Robot Control, Dubrovnik, Croatia, 5-7 September, 2012, pp. 767-772, doi: 10.3182/20120905-3-HR-2030.00154.
- [IC-5] **F. Ficuciello**, L. Villani, *Compliant Hand-Arm Control with Soft Fingers and Force Sensing for Human-Robot Interaction*, IEEE International Conference on Biomedical Robotics and Biomechatronics, Roma, Italy, 24-27 June, 2012, pp. 1961-1966, doi: 10.1109/BioRob.2012.6290863.
- [IC-4] **F. Ficuciello**, G. Palli, C. Melchiorri, B. Siciliano, *Planning and control during reach to grasp using the three predominant UB Hand IV postural synergies*, IEEE International Conference on Robotics and Automation, St. Paul, Minnesota, 14-18 May, 2012, pp. 2255-2260, doi: 10.1109/ICRA.2012.6224922.
- [IC-3] **F. Ficuciello**, G. Palli, C. Melchiorri, B. Siciliano, *Experimental evaluation of postural synergies during reach to grasp with the UB Hand IV*, IEEE/RSJ International Conference on Intelligent Robots and Systems, San Francisco, California, 25-30 September, 2011, pp. 1775–1780, doi: 10.1109/IROS.2011.6094671.
- [IC-2] **F. Ficuciello**, G. Palli, C. Melchiorri, B. Siciliano, *Experimental evaluation of the UB Hand IV postural synergies*, IEEE International Conference on Robotics and Automation, Workshop on Autonomous Grasping, Shanghai, China, 9-13 May, 2011.
- [IC-1] **F. Ficuciello**, R. Carloni, L.C. Visser, S. Stramigioli, *Port-Hamiltonian modeling for soft-finger manipulation*, IEEE/RSJ International Conference on Intelligent Robots and Systems, Taipei, Taiwan, 18-22 October, pp. 4281–4286, 2010, doi: 10.1109/IROS.2010.5650866.

National conference papers (refereed)

- [NC-5] **F. Ficuciello**, *Synergies and Underactuation: Learning and Control Strategies for Anthropomorphic Hands*, Convegno Annuale dei docenti e ricercatori italiani in AUTOMATICA, Roma, Italy, 5-7 September, 2016.
- [NC-4] F. Fazioli, **F. Ficuciello**, G.A. Fontanelli, L. Villani, B. Siciliano, *Soft-rigid collision algorithm for surgery realistic simulation in an open-source engine*, V Congresso del Gruppo Nazionale di Bioingegneria (GNB), Naples, Italy, 20-22 June 2016.
- [NC-3] **F. Ficuciello**, D. Zaccara, B. Siciliano, *Artificial Neural Network for Grasp Learning in a Synergy-based Framework*, V Congresso del Gruppo Nazionale di Bioingegneria (GNB), Naples, Italy, 20-22 June 2016.
- [NC-2] **F. Ficuciello**, L. Villani, B. Siciliano, *The role of Redundancy Resolution in Human-Robot Co-Manipulation*, Convegno Annuale dei docenti e ricercatori italiani in AUTOMATICA, Bergamo, Italy, 8-10 September, 2014.
- [NC-1] S. Di Martino, F. Ferrucci, **F. Ficuciello**, V. Lippiello, *A virtual reality-based haptic simulator for rehabilitation*, Workshop on Multimodal Interaction Through Haptic Feedback, Napoli, May 2008.

Other contributions (not refereed)

- F. Ficuciello**, V. Lippiello, F. Ruggiero, B. Siciliano, L. Villani, *Grasping and control of multifingered hands*, International Expert Days organized by Schunk, Haase, 2012.
- L. Villani, V. Lippiello, F. Ruggiero, **F. Ficuciello**, B. Siciliano, G. Palli, *Grasping and control of multifingered hands*, 11th IEEE-RAS International Conference on Humanoid Robots, Bled, Slovenia, 26-28 October, 2011.
- F. Ficuciello**, *Kinematic Patterns of the first three Postural Synergies of UB Hand IV*, 1th Convegno PRISMA, Forio d'Ischia, 2-4 June, 2011.

	F. Ficuciello , V. Lippiello, F. RUGGIERO, B. Siciliano, L. Villani, <i>Grasping unknown objects with robotics hands using vision and touch</i> , Italian National Meeting SIDRA, Siracusa, Italy, 17-19 September, 2009.
Ph.D. Thesis	
[TH]	F. Ficuciello , <i>Modelling and Control for Soft Finger Manipulation and Human-Robot Interaction</i> , Ph.D Thesis, Dec 2010.
Under revision	
[R2]	F. Ficuciello , "Synergy-based Control of Underactuated Anthropomorphic Hands", <i>IEEE Transactions on Robotics</i> , 2016.
[R1]	I. Cerulo, F. Ficuciello , V. Lippiello, B. Siciliano, "Telemanipulation of the Schunk S5FH Under-actuated Anthropomorphic Hand using Human Hand Motion Tracking", <i>Robotics and Autonomous Systems</i> , 2016.
Invited speaker and delivered seminars in other institutions	
November 2012	F. Ficuciello , Colloquium on <i>Autonomous Grasping for Dexterous Anthropomorphic Hands</i> , Department of Information Engineering, University of Siena, Italy.
March 2011	F. Ficuciello , D. D'auria <i>Nuova Frontiera della Robotica: Interazione e Cooperazione con l'Uomo</i> , Mostra: Donne e Scienza, Città della Scienza, Napoli.
April 2010	F. Ficuciello , Colloquium on <i>Port-based Modeling and Control of a Multifingered Robotic Hand with Soft Pad</i> , Control Engineering-EEMCS, University of Twente.
Journal and conference service	
From 2008 to 2015	Member of the Institute of Electrical and Electronics Engineers (IEEE) and of the IEEE-Robotics and Automation Society (RAS).
Associate Editor	
From 2012 to 2016	IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).
From 2014 to 2015	IEEE International Conference on Robotics and Automation (ICRA).
Program Committee member	IEEE International Conference on Robotics and Biomimetics, 2014, 2016.
Speaker in conference sessions	14th International Symposium on Experimental Robotics, 2014. IEEE International Conference on Biomedical Robotics and Biomechatronics, 2012. 14th International Symposium on Experimental Robotics, 2012. IEEE/RSJ International Conference on Intelligent Robots and Systems, 2011. IEEE/RSJ International Conference on Intelligent Robots and Systems, 2010.
Speaker in conference workshops	IEEE International Conference on Robotics and Automation, 2011.
Reviewer for international journals	The International Journal of Robotics Research, Robotics and Automation Magazine, IEEE Transactions on Robotics, IEEE Transactions on Mechatronics, Journal of NeuroEngineering and Rehabilitation, IEEE Transactions on Cybernetics, IEEE Transactions on Control Systems Technology, Journal of Robotics and Computer Integrated Manufacturing, International Journal of Humanoid Robotics, Transaction on Industrial Electronics, International Journal of Advanced Robotic Systems, Intelligent Service Robotics.

Reviewer for international conferences

IEEE International Conference on Robotics and Automation, IEEE/RSJ International Conference on Intelligent Robots and Systems, International IFAC Symposium on Robot Control, IEEE/RSJ International Conference on Advanced Intelligent Mechatronics, IEEE Multi-conference on Systems and Control, IEEE Conference on Decision and Control, International Conference on Applied Bionics and Biomechanics, IFAC Symposium on Robot Control, International Conference on Human Robot Interaction, International Symposium on Experimental Robotics, International Symposium on Advances in Robot Kinematics, International Conference on Humanoid Robots, IEEE International Conference on Automation Science and Engineering.

Attended seminar, tutorial and workshops

9 May 2016	Seminar on "Medical Robots Research at IPR – KIT Karlsruhe", delivered by Prof. Heinz Wörn, Institute of Process Control and Robotics Karlsruhe Institute of Technology, at University of Naples Federico II. 1 hour.
1 Dec 2015	Seminar on "Armi Autonome: Problemi Etici e Decisioni Politiche", delivered by Prof. Guglielmo Tamburrini, at University of Naples Federico II. 1 hour.
21-23 Oct 2015	8th Workshop on "Human friendly Robotics", Munich, Germany. 18 hours.
10-12 Sep 2015	5th Joint Workshop on "New Technologies for Computer/Robot Assisted Surgery", Brussels, Belgium. 18 hours.
3 Sep 2015	"Overview of Robotics and Autonomous Systems Activities at QUT by Prof Tristan Perez", delivered by Prof Tristan Perez, Queensland University of Technology in Brisbane Australia, at University of Naples Federico II. 1 hour.
21 Apr 2015	Seminar on "Colloquium on robotics: Six keynote talks by International Experts 2015", organized by Prof. B. Siciliano, speakers: Prof. O. Khatib, Prof. T. Asfour, Prof. R. Lumia, Prof. G. Indiveri, Prof. K. Kyriakopoulos, Dr. R. Madhavan, at Università degli Studi di Napoli Federico II. 4 hours.
29 Jan 2015	Seminar on "Perceptual Cues and Motion Control in Feature Networks", delivered by Dr. John Baillieul, Boston University, at University of Naples Federico II. 1 hour.
15 Jan 2015	Seminar on "Mechanics of solids: From beam theory to rapid prototyping for surgery planning", delivered by Prof. F. Auricchio, at University of Naples Federico II. 2 hours.
14 Jan 2015	Seminar on "Smoothed particle machine perception: A proposed method for sensor fusion and physical-spatial perception", delivered by Dr. N. Hockings, at University of Naples Federico II. 1 hour.
16 Sep 2014	Seminar on "Towards agile flight of vision-controlled micro-flying robots: From frame-based to event-based vision", delivered by Prof. D. Scaramuzza, at University of Naples Federico II. 1 hour.
23 Jun 2014	Seminar on "Control systems design using energy properties of physical systems", delivered by Dr. A. Donaire, at University of Naples Federico II. 1 hour.
12 Jul 2012	Seminar in "Vibro-elastography and image guidance for prostate cancer interventions", delivered by Prof. T. Salcudean, at University of Naples Federico II. 2 hours.
15 Jun 2012	Seminar on "Reengineering the Hand: Novel Approaches to Robotic Manipulation", delivered by Prof. A. Dollar, at University of Naples Federico II. 2 hours.
17 May 2012	Seminar on "Body intelligence in the hand: From human to artificial haptic", delivered by Prof. A. Bicchi, at University of Naples Federico II. 2 hours.
23 Nov 2011	Seminar on "Building Energy Doctors: SPC and Kalman Filter-based Fault Detection", delivered by Prof. P.B. Luh, at University of Naples Federico II. 2 hours.
17 Nov 2011	Seminar on "Guidance and control of fish shoals using biomimetic robots", delivered by Prof. M. Porfiri, at University of Naples Federico II. 2 hours.
16 Nov 2011	Seminar on "e-Heritage Projects in Italy, Cambodia, and Japan: Lesson learned", delivered by Prof. K. Ikeuchi, at University of Naples Federico II. 2 hours.
24 Oct 2011	Seminar on "Human-friendly robotics", delivered by Prof. O. Khatib, at University of Naples Federico II. 2 hours.
19 Oct 2011	Seminar on "Mobile manipulation — A key technology for the factory of the future", delivered by Dr. R. Bischoff, at University of Naples Federico II. 2 hours.

30 Sep 2011	Workshop on <i>"Robotics for Neurology and Rehabilitation"</i> , at IROS 2011, San Francisco, California, 8 hours.
4 May 2011	Seminar on <i>"A mechatronic approach to modeling and control of non-rigid robots in industrial practice"</i> , delivered by Eng. A. Bottero, at University of Naples Federico II. 2 hours.
27 Apr 2011	Seminar on <i>"Robot Hands: Current Trends in Design and Control"</i> , delivered by Prof. C. Melchiorri, at University of Naples Federico II. 2 hours.
23 Mar 2011	Seminar on <i>"Fault diagnosys for robotic systems: From theory to practical implementation"</i> , delivered by Prof. F. Caccavale, at University of Naples Federico II. 2 hours.
22 Oct 2010	Workshop on <i>"Performance Evaluation and Benchmarking for Intelligent Robots and Systems with Cognitive and Autonomy Capabilities"</i> , at IROS 2010, Taipei, Taiwan. 4 hours.
18 Oct 2010	Workshop on <i>"Grasp planning and task learning by imitation"</i> , at IROS 2010, Taipei, Taiwan. 8 hours.
6 Oct 2010	Workshop on <i>"Actuation and Sensing in Robotics"</i> , within DEXMART review meeting at Saarbrücken Rathaus. 8 hours.
Sep 2010	Workshop on <i>"Hyperflexible Robotic Workcells"</i> , delivered by Prof. F. Basile and P. Chiacchio, Salerno, 8 hours.
16 Dec 2009	Seminar on <i>"Microvibration Control of Precision Mechanism Using Active/Passive Piezoelectric Shunt Technique"</i> , delivered by Dr. Hao Sun, at University of Twente. 2 hours.
3 Nov 2009	Seminar on <i>"Dirac structures and Port-Hamiltonian systems"</i> , delivered by Prof. Stefano Stramigioli, at University of Twente. 3 hours.
30 Oct 2009	Seminar on <i>"Using simple models to guide the design of an energy-saving prosthetic foot"</i> , delivered by Dr. Steve Collins, Delft University of Technology – Delft Biorobotics Lab, at University of Twente. 2 hours.
29 Oct 2009	Seminar on <i>"Realistic modeling of medical interventions involving tool-tissue interactions has been considered to be"</i> , delivered by Prof. Sarthak Misra, MIRA Biomedical Technology and Technical Medicine, at University of Twente. 2 hours.
22 Oct 2009	Seminar on <i>"Some researches and teaching experiences on mechanical engineering at Bologna University"</i> , delivered by Dr. Andrea Zucchelli, University of Bologna, Mechanical Engineering Department, at University of Twente. 2 hours.
3 Jun 2009	Seminar on <i>"Human - Centered Robotics"</i> , delivered by Prof. Oussama Khatib, at University of Naples Federico II. 1 hour.
21 May 2009	Seminar on <i>"Robot: sogno e bisogno"</i> , delivered by Prof. Bruno Siciliano in Centro Congressi Federico II, Naples. 2 hours.
26 Jan 2009	Seminar on <i>"Measuring Fingertip Forces by Imaging the Fingernail"</i> , delivered by Prof. John Hollerback, School of Computing, University of Utah, at University of Naples Federico II. 2 hours.
18 Dec 2008	Seminar on <i>"Mirror neurons and point of view independence"</i> , delivered by Dr. R. Prevede, at University of Naples Federico II. 1 hour.
18 Dec 2008	Seminar on <i>"Mirror neurons and interaction"</i> , delivered by Eng. V. Cangiano, at University of Naples Federico II. 1 hour.
24 Oct 2008	Workshop on <i>"First workshop for young researchers on Human-friendly robotics"</i> , at Palazzo dell'Innovazione e della Conoscenza, Naples, Italy. 7 hours
22-26 Sep 2008	Workshop on <i>"Grasp and task learning by imitation"</i> , at IROS 2008, Nice, France. 8 hours.
15 Sep 2008	<i>"1st Dexmart Internal Workshop"</i> , at LAAS-CNRS, Toulouse, France. 4 hours.
Jul 2008	Doctorate class on <i>"Analysis, Simulations and Applications of Nonsmooth Systems"</i> , delivered by Prof. P.T. Piiroinen, at University of Naples Federico II. 8 hours.
Jun 2008	Doctorate class on <i>"H-infinity optimal control"</i> , delivered by Prof. A. Pironti, at University of Naples Federico II. 15 hours.
31 May 2008	Workshop on <i>"Multimodal Interaction Through Haptic Feedback"</i> , MITH 2008, Napoli. 8 hours.
May 2008	Doctorate class on <i>"Fuzzy Logic and Soft Computing"</i> , delivered by Prof. L. Landoli, at University of Naples Federico II. 16 hours.

14 Mar 2008	Seminar on " <i>Robotics and disability</i> ", delivered by Prof. A.Casals, at University of Naples Federico II. 2 hours.
20 Feb 2008	Seminar as part of the International Congress " <i>Robotics: A New Science</i> ", Accademia Nazionale dei Lincei, Roma. 10 hours.
24 Oct 2007	Seminar on " <i>Art and Robotics</i> ", delivered by Prof. Katsushi Ikeuchi, Pan, Palazzo delle arti, Naples. 4 hours.
14 Apr 2007	Tutorial on " <i>Nonlinear control of flexible joint robots</i> ", at ICRA 2007, Roma. 8 hours.

PhD school and courses

26-30 Nov 2012	Doctorate school " <i>Advanced Robotic Grasping</i> " delivered by Prof. Domenico Prattichizzo at University of Siena, 40 hours.
18-23 Sep 2011	Doctorate school HYPER 2011/IEEE Summer school on " <i>Neurorehabilitation: Emerging Technologies</i> ", La Alberca, Salamanca (Spagna). 40 hours.
15 Jun 2011	Doctorate school "F. Gasparini", lecture on " <i>Bioelectric and biomagnetic signals of the brain: from measurement to source reconstruction</i> ", University of Bologna. 8 hours.
12-17 Jul 2010	Doctorate school SIDRA Antonio Ruberti on " <i>Robotics</i> ", delivered by Prof. G. Oriolo, Prof. D. Prattichizzo and Prof. L. Villani, at Bertinoro Congress Center. 40 hours.
13-18 Jul 2009	Doctorate school SIDRA Antonio Ruberti on " <i>Lyapunov techniques for robust control of dynamic systems</i> ", delivered by Prof. F. Blanchini, at Bertinoro Congress Center. 40 hours.
16-20 Feb 2009	Doctorate school on " <i>Information Engineering</i> ", at University of Naples Federico II. 40 hours.
14-19 Jul 2008	Doctorate school SIDRA Antonio Ruberti on " <i>Introduction on non linear systems control</i> ", in Italian, delivered by Prof. A.Isidori, at Bertinoro Congress Center. 40 hours.
2008	M.SC Course on " <i>Controlli non lineari I</i> ", delivered by Prof. Mario Di Bernardo, University of Naples Federico II. 60 hours.
2008	M.SC Course on " <i>Identificazione e Controllo Ottimo</i> ", delivered by Prof. Francesco Garofano, University of Naples Federico II. 60 hours.
2008	M.SC Course on " <i>Controllo Robusto</i> ", delivered by Prof. Alfredo Pironti, University of Naples Federico II. 60 hours.
2008	M.SC Course on " <i>Robotica Avanzata</i> ", delivered by Prof. Bruno Siciliano, University of Naples Federico II. 60 hours.

Teaching activities

2008-until now	Teaching assistant for the class " <i>Robot Control</i> ", delivered by Prof. B. Siciliano, 'Laurea Specialistica' degree, School of Engineering, University of Napoli Federico II.
2014-2015	Teaching assistant for the class " <i>Automatica</i> ", delivered by Prof. Luigi Villani, 'Laurea Triennale' degree, School of Engineering, University of Napoli Federico II.
2008-2009	Teaching assistant for the class " <i>Fondamenti di Automatica</i> ", delivered by Prof. Luigi Villani, 'Laurea Triennale' degree, School of Engineering, University of Napoli Federico II.

Summary about teaching activities

Teaching support	During the above mentioned teaching activities, Fanny Ficuciello carried out several lessons both theoretical and practical, giving also personal didactic assistance to the students.
Supervision of students during their Bachelor and Master theses	Supervisor of around 30 students from the Faculty of Engineering, for both Bachelor degree and Master's degree thesis. This supervision activity has lead to the realization of a number of interesting applications in the robotic field with both experimental work in laboratory and theoretical/simulation studies. From students supervision activities have followed later also scientific publications.

Personal skills and competences

Mother tongue(s)

Other language(s)
Computer skills and competences

Programming languages

Middleware
Operating systems

Additional information

Hobbies and personal interests

Italian language

English language

Very good knowledge of MATLAB-SIMULINK environment, LaTeX, FRI Library.
Good knowledge of the programming language C++.
Good knowledge of, 20-sim, Graspit!, Inkscape.
Good knowledge of the robot oriented programming language RAPID.
Basic knowledge of the programming languages BASIC, PASCAL, FORTRAN.
Basic knowledge of ROS (Robot Operating Systems).
Windows. Linux.

Sports: Swimming, Tennis, Yoga
Musical instruments: Piano

Fanny Ficuciello is aware that, pursuant to and in accordance with Art. 26 about the law 15/68, mendacious statements, false acts and use of false acts are punishable pursuant to and in accordance with the penal code and special laws. The undersigned allows the use of personal data pursuant to and in accordance with Law 196/03.