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Matteo Luperto
CURRICULUM VITAE

INFORMAZIONI PERSONALI

COGNOME	LUPERTO
NOME	MATTEO
DATA DI NASCITA	22/01/1988

Data

13/07/2020

Luogo

Saronno

Matteo Luperto

Date of birth 22/01/1988
Citizenship Italian
Email matteo.luperto@unimi.it

Highlights

- Research Assistant at the Applied Intelligent System Laboratory (AISLab), Dipartimento di Informatica Giovanni Degli Antoni, Università degli Studi di Milano, since November 2016.
- Ph.D. in Information Technology from Artificial Intelligence and Robotics Lab (AIRLab), Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano (2017). Advisor Prof. F. Amigoni.
- Research interests in *semantic mapping* for autonomous mobile robots, focusing on techniques to retrieve the structure of indoor buildings from 2D maps, and Long-Term Autonomy for *Socially Assistive Robots*.
- Researcher, leader of WP7 (Community-Based Activity Center) for the H2020 research project *MoveCare*, since November 2016. The project, which involves a consortium of 14 European partners, integrates a robotic platform with an IoT-based domotic system and a virtual caregiver to provide transparent monitoring and social interventions for elders at home.
- Winner of the 2012 RoboCup Virtual Robot Competition Rescue Simulation League, Mexico.
- Publications: 3 papers in peer-reviewed international journals and 18 conference papers (16 overall as first or shared first author) in top-conferences and journals in the field of AI and robotics (Robotics and Autonomous Systems, Autonomous Robots, ICRA, IROS, and AAMAS). Academic age: 6 years.
- Organization and management of the pilot of the MoveCare project, which involved the long-term autonomous deployment of 10 mobile assistive robots in the own apartment of 30 elders in Milan (Italy) and Badajoz (Spain), for 10-12 weeks each. Experiments were performed with the collaboration of Junta de Extremadura, University of Malaga, University of Örebro, University of Manchester, Politecnico di Milano, and Università degli Studi di Milano, and were covered by the media of Spain and Italy.
- Organization and management of five pilot trial experiments with end-users in a study for cognitive assessment and stimulation of elderly people using digital activities and an autonomous mobile robot. These pilot studies were performed with the collaboration of Policlinico IRCCS Ca' Granda Milano, Fondazione Don Gnocchi, University of Manchester, University of Plymouth, Politecnico di Milano, and Università degli Studi di Milano, within the MoveCare project.
- Teaching assistant for the undergraduate courses of Fondamenti di Informatica (2014-19) and Informatica B (2013-17) at Politecnico di Milano, and for the courses of Realtà Virtuale (2017-19) and Sistemi Intelligenti Avanzati (2019-20) at the Università degli Studi di Milano.
- Cosupervisor of 15 M.Sc. theses at Politecnico di Milano and Università degli Studi di Milano.

Short bio

Matteo Luperto (Garbagnate Milanese, Italy, 22 January 1988) is a postdoctoral researcher with the Dipartimento di Informatica Giovanni Degli Antoni at the Università degli Studi di Milano (Italy). He received his Ph.D. in Information Technology from the Politecnico di Milano (Italy) in 2017. His main research interests are in *semantic mapping for autonomous mobile robots* and *social assistive mobile robotics*.

Position and Education

RECORD OF EMPLOYMENT

November 2016 – present

Research Assistant (post-doc) at the Dipartimento di Informatica Giovanni Degli Antoni, Università degli Studi di Milano, Applied Intelligent System Lab (AISLab - prof. A. Borghese), working on the H2020 Project “MoveCare - Multiple-Actors Virtual Empathic Caregiver for the Elder” (since Nov. 2016) and on the PON-MIUR Project “SI-ROBOTICS - SocIal ROBOTICS for active and healthy ageing” (since March 2020).

Project: *MoveCare* integrates an autonomous robotic platform, developed within the project, with an IoT-based domotic system, smart objects, a virtual community, and an activity center to provide, through Artificial Intelligence, assistance, activities, and transparent monitoring to the elder at home.

Role: Leader of WP7, “Community based Activity Center”. Conceptualization, development, and testing of a community-based activity center and of digitalized cognitive tests for transparent cognitive evaluation of elders at home; integration with the robotic platform and IoT domotic sensors. Testing and evaluation for Long-Term-Autonomy (LTA) of the MoveCare framework in pre-pilot studies with end-users for continuous integration, in coordination with partners of the MoveCare consortium. Organization and management of the Movecare pilot, with the deployment of the full architecture of the system and using 10 autonomous mobile robots for 10-12 consecutive weeks, inside the house of 30 end-users both in Spain and in Italy. Data analysis and evaluation of the results.

Project: *SI-ROBOTICS* aims to design, and to demonstrate the technical feasibility and acceptability, of novel solutions for Social Assistive Robots to assist elderly people in daily living activities and to assess the progress of their physical and cognitive decline.

Role: Leader of WP5.1, “Service profiling, selection and design of integrated scenarios”. Investigation of novel methods for cognitive stimulations and cognitive monitoring mediated by a socially assistive robot. Definition and development of an Human-Robot Interaction platform for cognitive activities. Integration and testing of the platform.

November 2013 – November 2016

Ph.D. student at the Artificial Intelligence and Robotics Lab (AIRLab), Dipartimento di Elettronica Informazione e Bioingegneria, Politecnico di Milano. Advisor: prof. Francesco Amigoni.

Research topic: Semantic modeling of indoor environments for autonomous mobile robots integrating a priori knowledge about the structure of the building.

February 2013 – September 2013

Internship at the HOC-LAB - Hypermedia Open CenterLab - Dipartimento di Elettronica e Informazione of the Politecnico di Milano, prof. Paolo Paolini, working on the development of the online storytelling platform for e-learning “1001Storia”. The platform, still used today for the Policultura Project, has been used by more than 1000 students and teachers for e-learning activities.

EDUCATION

- Ph.D. in Information Technology at Politecnico di Milano, Milano, Italy.
November 2013 - February 2017.
Title: *Semantic Modeling of the Global Structure of Buildings*
Advisor: *F. Amigoni*
Reviewers: *M. Hanheide (University of Lincoln), F. Pecora (University of Örebro)*
Thesis: <https://www.politesi.polimi.it/handle/10589/132104>
- M.Sc. in Computer Science Engineering at Politecnico di Milano, Milano, Italy.
September 2010 - December 2012 / Grade: 110L/110.
Thesis title: *Semantic Labeling of Places Using Building Typology Knowledge in Mobile Robotics*,
Advisor: *F. Amigoni*
- B.Sc. in Computer Science Engineering at Politecnico di Milano, Milano, Italy.
September 2007 - September 2010 / Grade: 110L/110.
Thesis title: *Integration of Visual Landmarks in a ScanSLAM Algorithm*,
Advisor: *M. Matteucci*
- High School diploma at Liceo Scientifico G.B.Grassi, Saronno, Italy.
2002- 2007.

VISITING EXPERIENCES

- Visiting researcher at the MACHine Perception and Intelligent Robotics (MAPIR) Laboratory, Prof, Javier Gonzalez-Jimenez, University of Malaga, Spain, July 2019.
- Visiting researcher at Department of Computer Science - Declarative Languages and Artificial Intelligence, Prof. Luc de Raedt , KU Leuven, Belgium, June 2015.

EDUCATION - OTHERS

- Participation to the summer school on “Long-Term Autonomy for Mobile Robotics” (LAMoR), Lincoln Centre for Autonomous Systems (L-CAS), Lincoln University, UK, August-September 2015.
- Participation to the second Örebro Winter School on “Artificial Intelligence and Robotics” (LUCIA), Örebro Universitet, Sweden, December 2014.
- Exchange M.Sc student in Computer Science Engineering within the ERASMUS project at Chalmers Tekniska Högskola, Göteborg, Sweden, August 2010 - January 2011.

SCHOLARSHIPS

- Scholarship from Ministero dell’Istruzione, dell’Università e della Ricerca for attending the XXIX PhD Cycle, November 2013 - November 2016.
- ERASMUS Scholarship as an exchange student at Chalmers Tekniska Högskola, Göteborg, Sweden, August 2010 - January 2011.

Awards

- AW.1. Paper “Robot Exploration Using Knowledge of Inaccurate Floor Plans” [IC.5] selected among the best papers of the conference, and invited for inclusion in a special issue of the dedicated journal, at the European Conference on Mobile Robots (ECMR 2019), Prague (Czech Republic), September 2019.
- AW.2. Best paper award nomination for “Extracting Structure of Buildings using Layout Reconstruction” [IC.11], 15th International Conference on Intelligent Autonomous Systems (IAS-15), Baden-Baden (Germany), June 2018.
- AW.3. PhD Scholarship from Ministero dell’Istruzione, dell’Università e della Ricerca for attending the XXIX PhD Cycle at Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, 2013.
- AW.4. Winner of the RoboCup Virtual Robot Competition Rescue Simulation League, RoboCup 2012, with “PoAReT”- Politecnico di Milano Autonomous Rescue Team [OH.4], Mexico City, June 2012.

Complete Publication List

REFEREED INTERNATIONAL JOURNALS

- JR.1. Francesca Lunardini*, Matteo Luperto*, Simona Ferrante, Nicola Basilico, Alberto Borghese, Katia Daniele, Carlo Abbate, Sarah Damanti, Daniela Mari, Matteo Cesari, "Supervised digital neuropsychological tests for cognitive decline in elderly: usability and clinical validity", *Journal of Medical Internet Research - JMIR mHealth and uHealth - JMU*, 2020. (accepted for publication, to appear).
- JR.2. Matteo Luperto, Francesco Amigoni, "Predicting the Global Structure of Indoor Environments: A Constructive Machine Learning Approach," *Autonomous Robots*, 2018.
doi: <https://doi.org/10.1007/s10514-018-9732-7>
ANVUR (ING-INF/05) RANK: 2
- JR.3. Francesco Amigoni, Matteo Luperto, Viola Schiaffonati, "Towards Generalization of Experimental Results for Autonomous Robots," *Robotics and Autonomous Systems*, Vol. 90, no. 4, pp. 4-14, 2017.
doi: <https://doi.org/10.1016/j.robot.2016.08.016>
ANVUR (ING-INF/05) RANK: 1

REFEREED INTERNATIONAL CONFERENCES

- IC.1. Jennifer Renoux, Matteo Luperto, Nicola Basilico, Marta Romeo, Marios Milis, Francesca Lunardini, Simona Ferrante, Amy Loufti, N. Alberto Borghese, "A Virtual Caregiver for Assisted Daily Living of Pre-Frail Users", *to be presented at the "43rd German Conference on Artificial Intelligence (KI2020)"*, accepted for publication.
- IC.2. Davide Azzalini, Alberto Castellini, Matteo Luperto, Alessandro Farinelli, Francesco Amigoni, "HMMs for Anomaly Detection in Autonomous Robots", *Proceedings of "International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2020)"*, Auckland, New Zealand, May 2020.
CORE rank: A*; cited on CSRankings.
- IC.3. Matteo Luperto, Marta Romeo, Francesca Lunardini, Nicola Basilico, Carlo Abbate, Ray Jones, Angelo Cangelosi, Simona Ferrante, N. Alberto Borghese, "Evaluating the Acceptability of Assistive Robots for Early Detection of Mild Cognitive Impairment", *Proceedings of "IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2019)"*, Macao, China, October 2019.
doi: <https://doi.org/10.1109/IROS40897.2019.8968234>
CORE rank: A; cited on CSRankings.
- IC.4. Matteo Luperto, Javier Monroy, J. Raul Ruiz-Sarmiento, Francisco Angel Moreno, Nicola Basilico, Javier Gonzalez-Jimenez, N. Alberto Borghese, "Towards Long-Term Deployment of a Mobile Robot for at-Home Ambient Assisted Living of the Elderly", *Proceedings of the "European Conference on Mobile Robots (ECMR 2019)"*, Prague, Czech Republic, September 2019.
doi: <https://doi.org/10.1109/ECMR.2019.8870924>
- IC.5. Matteo Luperto, Francesco Amigoni, Danilo Fusi, N. Alberto Borghese, "Robot Exploration Using Knowledge of Inaccurate Floor Plans", *Proceedings of the "European Conference on Mobile Robots (ECMR 2019)"*, Prague, Czech Republic, September 2019.
doi: <https://doi.org/10.1109/ECMR.2019.8870925>
- IC.6. Matteo Luperto, Valerio Arcerito, Francesco Amigoni, "Predicting the Layout of Partially Observed Rooms from Grid Maps", *Proceedings of "IEEE International Conference on Robotics and Automation (ICRA 2019)"*, Montreal, Canada, May 2019.
doi: <https://doi.org/10.1109/ICRA.2019.8793489>
CORE rank: B; cited on CSRankings.
- IC.7. Matteo Luperto, Francesco Amigoni, Danilo Fusi, N. Alberto Borghese, "Exploiting Inaccurate A Priori Knowledge in Robot Exploration", *Proceedings of "International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019)"*, extended abstract, Montreal, Canada, May 2019.
CORE rank: A*; cited on CSRankings.
- IC.8. Francesca Lunardini, Matteo Luperto, Marta Romeo, Jennifer Renoux, Nicola Basilico, Andrej Krpic, Alberto Borghese, Simona Ferrante, "The MOVECARE Project: Home-based Monitoring of Frailty," *Proceedings of the "IEEE International Conference on Biomedical and Health Informatics" (BHI'19)*, May 2019.
doi: <https://doi.org/10.1109/BHI.2019.8834482>
- IC.9. Francesca Lunardini, Matteo Luperto, Simona Ferrante, Nicola Basilico, Alberto Borghese, Katia Daniele, Carlo Abbate, Sarah Damanti, Daniela Mari, Matteo Cesari, "Validity of digital Trail Making Test and Bells test in elderlies," *Proceedings of the "IEEE International Conference on Biomedical and Health Informatics" (BHI'19)*, May 2019.
doi: <https://doi.org/10.1109/BHI.2019.8834513>

- IC.10. Francesco Amigoni, Matteo Luperto, Valerio Castelli, "Improving Repeatability of Experiments by Automatic Evaluation of SLAM Algorithms", *Proceedings of "IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2018)"*, Madrid, Spain, October 2018.
doi: <https://doi.org/10.1109/IR0S.2018.8594189>
CORE rank: A; cited on CSRankings.
- IC.11. Matteo Luperto, Francesco Amigoni, "Extracting Structure of Buildings using Layout Reconstruction" *Proceedings of the "15th International Conference on Intelligent Autonomous Systems (IAS-15)"*, Baden-Baden, Germany, June 2018.
doi: https://doi.org/10.1007/978-3-030-01370-7_51
- IC.12. Matteo Luperto, Marta Romeo, Nicola Basilico, Alberto Borghese, Angelo Cangelosi, Ray Jones, Simona Ferrante, Francesca Lunardini, "Digitalized Cognitive Assessment Mediated by a Virtual Caregiver," *Proceedings of the "International Joint Conference on Artificial Intelligence (IJCAI 2018)"*, demo track, Stockholm, Sweden, June 2018.
doi: <https://doi.org/10.24963/ijcai.2018/856>
CORE rank: A*; cited on CSRankings.
- IC.13. Alessandro Vuono, Matteo Luperto, Jacopo Banfi, Nicola Basilico, Alberto Borghese, Micheal Sioutis, Jennifer Renoux, Amy Loufty, "Seeking Prevention of Cognitive Decline in Elders via Activity Suggestion by A Virtual Caregiver," *Proceedings of the "International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2018)"*, demo track, Stockholm, Sweden, June 2018.
CORE rank: A*; cited on CSRankings.
- IC.14. Matteo Luperto, Alessandro Riva, Francesco Amigoni, "Semantic Classification by Reasoning on the Whole Structure of Buildings using Statistical Relational Learning Techniques," *Proceedings of the "IEEE International Conference on Robotics and Automation (ICRA 2017)"*, Singapore, Singapore, September 2017.
doi: <https://doi.org/10.1109/ICRA.2017.7989298>
CORE rank: B; cited on CSRankings.
- IC.15. Francesco Amigoni, Jacopo Banfi, Alessandro Longoni, Matteo Luperto, "Online Switch of Communication Modalities for Efficient Multirobot Exploration," *Proceedings of the "European Conference on Mobile Robots (ECMR 2017)"*, Paris, France, September 2017.
doi: <https://doi.org/10.1109/ECMR.2017.8098699>
- IC.16. Matteo Luperto, Leone D'Emilio, Francesco Amigoni, "A Generative Spectral Model for Semantic Mapping of Buildings," *Proceedings of "IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2015)"*, Hamburg, Germany, October 2015.
doi: <https://doi.org/10.1109/IR0S.2015.7354009>
CORE rank: A; cited on CSRankings.
- IC.17. Matteo Luperto, Francesco Amigoni, "Exploiting Structural Properties of Buildings Towards General Semantic Mapping Systems," *Proceedings of the "Thirteen International Conference on Intelligent Autonomous Systems (IAS-13)"*, Padova, Italy, July 2014.
doi: https://doi.org/10.1007/978-3-319-08338-4_28
- IC.18. Matteo Luperto, Francesco Amigoni, Alberto Quattrini Li, "A System for Building Semantic Maps of Indoor Environments Exploiting the Concept of Building Typology," *Proceedings of the "RoboCup International Symposium (RoboCup 2013)"*, Eindhoven, Netherlands, July 2013.
doi: https://doi.org/10.1007/978-3-662-44468-9_44
CORE rank: B.

WORKSHOPS

- WS.1. Matteo Luperto, Luca Fochetta, Francesco Amigoni, "Exploration of Indoor Environments Predicting the Layout of Partially Observed Rooms", *Workshop on Autonomous Robots and Multirobot Systems (ARMS) at the International Conference on Autonomous Agents and Multiagent Systems (AAMAS-2020)*, Auckland, New Zealand, May 2020.
- WS.2. Matteo Luperto, Francesco Amigoni, Danilo Fusi, N. Alberto Borghese, "Exploiting Inaccurate A Priori Knowledge in Robot Exploration", *Workshop on Autonomous Robots and Multirobot Systems (ARMS) at the International Conference on Autonomous Agents and Multiagent Systems (AAMAS-2019)*, Montreal, Canada, May 2019.
- WS.3. Matteo Luperto, Javier Monroy, Francisco-Angel Moreno, J.Raul Ruiz-Sarmiento, Nicola Basilico, Javier Gonzalez Jimenez, N.Alberto Borghese "A Multi-Actor Framework Centered around an Assistive Mobile Robot for Elderly People Living Alone," *Workshop on Robots for Assisted Living, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2018)*, Madrid, Spain, October 2018.
- WS.4. Francesco Amigoni, Matteo Luperto, Valerio Castelli, Fabio Bonsignorio, "Predicting Robot Performance: Why and How," *Federated AI for Robotics Workshop (joint IJCAI-ECAI/ICML/AAMAS Workshop)*, Stockholm, Sweden, July 2018.

- WS.5. Francesco Amigoni, Jacopo Banfi, Alessandro Longoni, Matteo Luperto, "Online Switch of Multirobot Communication Modalities for Efficient Exploration," *Workshop on "Multi-robot Perception-Driven Control and Planning"*, *IEEE International Conference on Robotics and Automation (ICRA 2017)*, Singapore, June 2017.
- WS.6. Matteo Luperto, Francesco Amigoni, "A Constructive Machine Learning Approach for Robot Exploration and Search," *Proceedings of the "IROS2015 (IEEE/RSJ International Conference on Intelligent Robots and Systems) Workshop on Machine Learning in Planning and Control of Robot Motion (MLPC17)"*, Hamburg, Germany, October 2015.
- WS.7. Francesco Amigoni, Matteo Luperto, Viola Schiaffonati, "Towards Generalization of Experimental Results for Autonomous Robots," *IAS-13 (Thirteen International Conference on Intelligent Autonomous Systems) Workshop on "New Research Frontiers for Intelligent Autonomous Systems (NRF-IAS-2014)"*, Venezia, Italy, July 2014 .

OTHERS

- OH.1. Technical Supervisor for the Italian translation of the divulgative book "Intelligenza Artificiale," Discovery Edizioni, June 2019.
- OH.2. N. Alberto Borghese, Nicola Basilico, Jacopo Essenziale, Matteo Luperto, Renato Mainetti, "IA nelle piattaforme di e-health ed e-Welfare," *Ital-IA*, Roma, Italy, February 2019.
- OH.3. Francesco Amigoni, Matteo Luperto, Alberto Quattrini Li, "Towards More Realistic Indoor Environments for the Virtual Robot Competition," *RoboCup2014 Team Description Papers*, Joao Pessoa, Brasil, July 2014.
- OH.4. Francesco Amigoni, Alain Caltieri, Riccardo Cipolleschi, Riccardo Conconi, Michele Giusto, Matteo Luperto, Mladen Mazurán "PoAReT Team Description Paper," *RoboCup2012 Team Description Papers*, Mexico City, Mexico, June 2012.

CONTRIBUTIONS UNDER REVIEW AND PREPRINTS

Contributions Under Review in Refereed International Journals

- Matteo Luperto, Francesco Amigoni, *Reconstructing the Structure of Buildings from Partial 2D Metric Maps*, under review at Engineering Application of Artificial Intelligence - extended version of [IC.6].
- Matteo Luperto, Michele Antonazzi, N. Alberto Borghese, Francesco Amigoni, *Indoor Robot Exploration Using Inaccurate Prior Knowledge*, under review at Robotics and Autonomous Systems (minor revisions) - extended version of [IC.5] - invited contribution.

PREPRINTS

- Matteo Luperto, Javier Monroy, J. Raul Ruiz-Sarmiento, Francisco Angel Moreno, Nicola Basilico, Jennifer Renoux, Andrej Krpic, Marios Milis, Javier Gonzalez-Jimenez, N. Alberto Borghese, *Integration of IoT-based Monitoring and a Service Robot for At-home Ambient Assisted Living for the Elders*, to be submitted to Robotics and Autonomous Systems (expected submission date July 2020) - extended version of [IC.4].
- Matteo Luperto, Francesco Amigoni, *Exploration of Indoor Environments Predicting the Layout of Partially Observed Rooms* - extended version of [WS.1], submitted to the a symposium canceled due to the Covid-19 outbreak. To be resubmitted, available at <https://arxiv.org/abs/2004.06967>.
- Tomasz Piotr Kucner, Stephanie Lowry, Matteo Luperto, Martin Magnusson, Achim J. Lilienthal, *Robust Frequency-Based Structure Extraction*, - improved version of <https://arxiv.org/pdf/2004.08794.pdf>, to be submitted to IEEE Robotics and Automation Letters (expected submission date September 2020).

Professional Activities

NATIONAL AND INTERNATIONAL RESEARCH PROJECTS

Matteo Luperto has contributed actively in the following research projects:

- *SI-ROBOTICS - Social ROBOTICS for active and healthy ageing*,
PROGRAM PON RICERCA E INNOVAZIONE - MIUR
- *MoveCare - Multiple-Actors Virtual Empathic Caregiver for the Elder*,
PROGRAMME H2020-ICT-26B-2016
(Project Leader: prof. A. Borghese - AISLab - Università degli Studi di Milano)
- *RoboCup Rescue 2012: Autonomous Mobile Robots for Search and Rescue Application*,
FONDAZIONE BANCA DEL MONTE DI LOMBARDIA
(Project Leader: prof. F. Amigoni - AIRLab - Politecnico di Milano)

PROGRAM COMMITTEE MEMBERSHIP

Matteo Luperto was a member of the Program Committee of the following conferences:

- Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence (AAAI), 2020 (AAAI20)
- International Conference on Autonomous Agents and Multiagent Systems (AAMAS), 2019 (AAMAS19), 2020 (AAMAS20).
- European Conference on Mobile Robots (ECMR), 2019 (ECMR19).
- Workshop on Autonomous Robots and Multirobot Systems (ARMS) at the International Conference on Autonomous Agents and Multiagent Systems (AAMAS), 2019 (ARMS19), 2020 (ARMS20).

REFeree SERVICES

Matteo Luperto is a reviewer for the following journals:

- IEEE Transaction on Robotics (T-RO), 2019.
- Robotics and Autonomous Systems, 2017, 2019, 2020.
- Autonomous Robots, 2019.
- Engineering Application of Artificial Intelligence (EAAI), 2019.
- Control Engineering Practice, 2019, 2020.
- IEEE Robotics and Automation Letters (RA-L), 2019, 2020.
- Interaction Studies, 2019.
- IEEE Transactions on Automation Science and Engineering (T-ASE), 2018, 2019.
- MDPI Applied Sciences, 2018, 2019.
- Remote Sensing, 2019.
- Transaction on GIS, 2019, 2020.

Matteo Luperto is a reviewer for the following conferences:

- IEEE International Conference on Robotics and Automation, 2017 (ICRA2017), 2018 (ICRA2018), 2019 (ICRA2019), 2020 (ICRA2020).
- IEEE/RSJ International Conference on Intelligent Robots and Systems, 2015 (IROS2015), 2016 (IROS2016), 2017 (IROS2017), 2018 (IROS2018), 2019 (IROS2019), 2020 (IROS2020).
- International Conference on Autonomous Agents and Multiagent Systems (AAMAS), 2019 (AAMAS19), 2020 (AAMAS20).
- Association for the Advancement of Artificial Intelligence (AAAI), 2020 (AAAI20).
- European Conference on Mobile Robots (ECMR), 2019 (ECMR2019).
- GNB, National Congress of Bioengineering, 2018 (GNB18).
- IEEE Symposium Series on Computational Intelligence, 2014 (SSCI2014).

MEMBERSHIPS

Matteo Luperto is member of the following associations:

- IEEE, the Institute of Electrical and Electronics Engineers.
- AI*IA, Associazione Italiana per l'Intelligenza Artificiale.

CONTRIBUTION TO PILOT STUDIES

Matteo Luperto has contributed to the design, organization, and management of the following pilot experiments with end-users for the H2020 MoveCare project, which aims to develop an assisted living framework integrating an autonomous mobile robot for the healthy aging of elders living at home:

- Pilot testing of the MoveCare framework with end-user in full autonomy in their apartments for 12 weeks in Milano, Italy.
Description: during this pilot study the entire MoveCare framework, composed of an IoT monitoring system, a set of digital activities, and an autonomous mobile robot was tested in 14 real elder apartments in Milan. Seven users were provided with an autonomous Giraff robot, while seven users tested the platform without the robot. The systems were fully autonomous, inside the actual the elders' houses, for a continuous-time of 10-12 weeks. Evaluation of the system was with user questionnaires and with collection and analysis system datasets. The set of experiments were covered local and national media. A similar experiment was performed, in parallel, in 16 apartments in Spain, in Badajoz, Extremadura.
Duration of the experiments: 10-12 weeks, October-December 2019 (first trial) 12 Weeks, January-March 2020 (second trial).
Number of participants: 14.
- Pre-pilot testing of the entire MoveCare framework with end-users in the assisted living facility of Servimayor, Jarandilla de la Vera, Extremadura, Spain.
Description: during this pre-pilot study the entire MoveCare framework, composed of an IoT monitoring system, a set of digital activities and an autonomous mobile robot was tested with end-users in a controlled apartment inside the assisted living facility of Servimayor, in Jarandilla de la Vera, Spain. The set of experiments were covered by local and national Spanish television (in the main news broadcasting program of Spain), by local and national radio, and by the local and national press.
Duration of the experiments: 2 weeks, July 2019. Number of participants: 8.
- Testing of the Community Based Activity Center (CBAC) developed by the Applied Intelligent System Lab (AISLab) for the MoveCare project
Description: during this pilot study we tested a multi-actor framework for cognitive, physical and social stimulation developed for elders living alone [IC.13]. We deployed the system in the house of 16 end-users of the platform, namely elders older than 65 years old and with no Mild Cognitive Impairment (MCI), collecting data about the system robustness and usability, improving the system following the paradigm of continuous integration and human-centered design.
Duration of the pilot study: 8 weeks, November and April 2018. Number of participants: 16.
- Evaluation of the use of an assistive robot for neuropsychological assessment of elders - joint collaboration with University of Manchester, University of Plymouth, and Politecnico di Milano - at the Assisted Living Lab of the Plymouth University, Plymouth, UK.
Description: during this pilot study we tested the use of an assistive robot as a supervisor and virtual caregiver for elders while doing a battery of cognitive tests. We collected data about the system robustness and usability. Results obtained during the development of the platform were presented at [IC.12], [IC.3].
Duration of the pilot study: 1 week, July 2018. Number of participants: 16.
- Testing of the digitalized version of cognitive tests for elders - joint collaboration with Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico and Politecnico di Milano - at the Policlinico Cà Granda Ospedale Maggiore, Reparto di Geriatria.
Description: during this pilot study we tested and validated against their paper-and-pencil counterparts the development of digitalized versions of cognitive tests for detecting MCI. The dataset acquired was consequently used for data analysis. The results of the pilot studies are presented in [IC.9] and are currently under review in a journal paper.
Duration of the pilot study: 1 year, October 2017 - October 2018. Number of participants: 83.

PROFESSIONAL ACTIVITY

- Technical Supervisor for the Italian translation of the divulgative book on Artificial Intelligence, "L'Intelligenza Artificiale", part of a book series on "Challenges on Engineering", Discovery Publisher - Edizioni Discovery, 2019.
- Invited Contributor for the innovation platform for developers of Telecom Italia, TIM OPEN, 2016.

Talks and Seminars

PRESENTATION AT INTERNATIONAL CONFERENCES

- "Exploration of Indoor Environments Predicting the Layout of Partially Observed Rooms", presented at the Workshop on Autonomous Robots and Multirobot Systems (ARMS) at the International Conference on Autonomous Agents and Multiagent Systems (AAMAS-2020), Auckland, New Zealand, May 2020.
- "Robot Exploration Using Knowledge of Inaccurate Floor Plans", presented at the European Conference on Mobile Robots (ECMR 2019), Prague, 2019.

- “Towards Long-Term Deployment of a Mobile Robot for at-Home Ambient Assisted Living of the Elderly”, presented at the European Conference on Mobile Robots (ECMR 2019), Prague, 2019.
- “MoveCare - Multiple-Actors Virtual Empathic Caregiver for the Elder”, presented at ICT-2018, Wien, 2018.
- “Improving Repeatability of Experiments by Automatic Evaluation of SLAM Algorithms”, presented at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2018), Madrid, 2018.
- “A Multi-Actor Framework Centered around an Assistive Mobile Robot for Elderly People Living Alone”, presented at the Workshop on Robots for Assisted Living, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2018), Madrid, 2018.
- “Digitalized Cognitive Assessment Mediated by a Virtual Caregiver”, presented at the International Joint Conference on Artificial Intelligence (IJCAI 2018) - demo track, Stockholm, 2018.
- “Predicting Robot Performance: Why and How”, presented at the Federated AI for Robotics Workshop, joint IJCAI-ECAI/ICML/AAMAS Workshop (FAIR 2018), Stockholm, 2018
- “A Generative Spectral Model for Semantic Mapping of Buildings”, presented at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2015), Hamburg, 2015.
- “A Constructive Machine Learning Approach for Robot Exploration and Search”, presented at the IROS2015 (IEEE/RSJ International Conference on Intelligent Robots and Systems) Workshop on Machine Learning in Planning and Control of Robot Motion (MLPC17), Hamburg, 2015.
- “Exploiting Structural Properties of Buildings Towards General Semantic Mapping Systems”, presented at the Thirteen International Conference on Intelligent Autonomous Systems (IAS-13), Padova, 2014.
- “Towards Generalization of Experimental Results for Autonomous Robots”, presented at IAS-13, Thirteen International Conference on Intelligent Autonomous Systems) Workshop on New Research Frontiers for Intelligent Autonomous Systems (NRF-IAS-2014), Venice, 2014.

SEMINARS

- “Towards long-term robot autonomy integrating AI and Robotics: the STRANDS example”, Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano (Italy), 2015.
- Lectures on “Audio techniques for Virtual Reality” for the course “Virtual Reality”, Prof. Alberto Borghese, Università degli Studi di Milano (Italy), years 2016/17, 2017/2018, 2018/2019, 6h.
- Presentation of the project “MoveCare - Multiple-Actors Virtual Empathic Caregiver for the Elder” at the course of “Startup and innovation”, Prof. Benassi, Università degli Studi di Milano (Italy), 2019.
- Lectures on “Introduction to Autonomous mobile robotics” for the course “Sistemi Intelligenti”, Prof. Alberto Borghese, Università degli Studi di Milano (Italy), years 2019/20 8h.

Teaching activities

TEACHING ASSISTANT

Sistemi Intelligenti Avanzati

teaching assistant

Prof. Alberto Borghese - Computer Science - Università degli Studi di Milano
Graduate level - seminar on Introduction to Autonomous Mobile Robotics (8h)
Year: 2019/2020.

Fondamenti Di Informatica

teaching assistant - esercitazioni

Prof. Cristiana Bolchini - Computer Engineering - Politecnico di Milano
Undergraduate level. (20h)
Year: 2018/2019.

Realtà Virtuale

teaching assistant

Prof. Alberto Borghese - Computer Science - Università degli Studi di Milano
Graduate level - seminar on Spatial Audio techniques for Virtual Reality (6h)
Years: 2016/2017, 2017/2018, 2018/2019.

Winter School on Industry 4.0: How the fourth industrial revolution will change the manufacturing environment

teaching assistant
Prof. Marco Taish - Alta Scuola Politecnica (ASP), Politecnico di Torino and Politecnico di Milano
Higher education graduate level. (30h)
Year: 2017-2018.

Fondamenti Di Informatica

teaching assistant - responsabile di laboratorio
Prof. Cristiana Bolchini - Computer Engineering - Politecnico di Milano
Undergraduate level. (18/20h)
Years: 2014/2015, 2015/2016, 2016/2017, 2017/2018.

Informatica B

teaching assistant - responsabile di laboratorio
Prof. Vittorio Zaccaria - Mechanical and Energy Engineering - Politecnico di Milano
Undergraduate level. (18/20h)
Years: 2013/2014, 2014/2015, 2015/2016, 2016/2017.

Informatica B

lab. tutor - tutor di laboratorio
Informatica B
Mechanical and Energy Engineering - Politecnico di Milano - Undergraduate level. (150h)
Year: 2012/2013.

STUDENTS' SUPERVISION

Graduate Students Supervision/Co-Advisor

- *Leone D'Emilio* 2014, "Un modello generative spettrale basato su grafi per il mapping semantico di edifici", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Michele Launi* 2015, "Reasoning on the whole structure of buildings using a Logical Relational Learning Framework", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Mattia Di Vitto, Modestino Cucciniello* 2015, "Modellazione e predizione di mappe semantiche di edifici tramite graph kernel e tecniche Monte Carlo Markov-Chain", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Matteo Calabrese* 2016, "Costruzione di Mappe Multilivello per Robot Mobili Autonomi", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Valerio Arcerito* 2017, "Modellazione e predizione della struttura di ambienti indoor per la robotica mobile a partire da una mappa parzialmente esplorata", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *David Lorenzi* 2017, "The influence of starting position in single-robot exploration performances", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Matteo Pasina* 2017, "A system for automatically evaluating the quality of maps built by autonomous mobile robots", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Danilo Fusi* 2018, "Speeding up single-robot exploration performances using a-priori knowledge from blueprints", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Valerio Castelli* 2018, "Prediction of the map quality obtained from 2D SLAM", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Nicola Sturari* 2019, "Dal Grafo alla Planimetria: generazione procedurale di planimetrie di ambienti indoor", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Luca Fochetta* 2019, "Use of Predicted Layout of Indoor Environments in Exploration Strategies for Autonomous Mobile Robotics", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Lin Chang, Li Mingju* 2019, "A data-driven approach for early stopping in autonomous robot exploration based on convolutional neural networks", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Stefano Carideo* 2019, "Procedural generation of realistic building layouts from graphs", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)
- *Federico Amadelli* 2020, "A method for predicting layouts of multiple closed rooms", M.Sc. in Computer Science and Engineering, Politecnico di Milano (Italy)

Currently Co-Advisor of 4 M.Sc. and 2 B.Sc. thesis at Università degli Studi di Milano (Italy) and Politecnico di Milano (Italy).

Research Interests

1 Reasoning about the Structure of Buildings for Autonomous Mobile Robotics

Autonomous mobile robots can perform many different tasks to help humans during their activities or to replace them in hazardous environments and simple routine operations. When we consider indoor tasks, robots have to interact with environments that are specifically designed for human activities, buildings.

Buildings are strongly structured environments that are organized in regular patterns. For instance, rooms typically have a geometrical structure that is characterized by features, such as walls perpendicular to the floor and to the ceiling, and by a layout that can be, in most cases, approximated by a box-like model.

To increase their ability to autonomously operate in indoor environments, robots must have a good understanding of buildings, in a way similar to the one that human beings exploit during their everyday activities. If we consider how people and robots interact with indoor environments, it can be said that people naturally understand and “read” buildings as human-made environments (and act in them accordingly) and that this is hardly the case for autonomous mobile robots.

Typically, the interaction between a robot and its environment is heavily based on data acquired with perception. Such data are used for constructing *metric* and *semantic maps* of the environment, where the former are used to represent the occupancy and the free space perceived by the robot, and the latter are abstract representations built on top of metric maps that aim to represent the meaning of parts of the perceived environment to provide robots a human-like understanding of their surroundings. Mapping methods usually provide reliable knowledge only on parts of the environment that have been already visited. This approach often implies that what has not been seen by the robot does not exist, adopting, in a sense, a closed world assumption on the environment. This form of interaction with the environment is radically different from that of humans, who can easily navigate and comprehend the structure of buildings even without having seen them before.

Our main research interest moves from the consideration that the global structure of buildings could be exploited to increase the autonomous abilities of robots when operating in indoor environments [IC.5]. Our proposed framework aims at identifying and at overcoming the limitations in standard mapping methods by starting from two insights on indoor environments. At first, we consider an entire floor of a building as a single object, by identifying relations between different (and potentially unconnected) parts of the building, such as walls, which can be used to infer the possible structure of unobserved parts of the building, as unexplored rooms behind closed doors [IC.10],[IC.6],[IC.11] [IC.5]. Moreover, we consider each building in relation to other buildings with the same function [JR.2]. The function of a building is represented by the main activity that each building is designed for (e.g., an office, a school) and is captured by the concept of *building type* [IC.18]. The function of a building imposes its structure, its floor plan, and the structure of its rooms. This allows us to exploit the fact that each building, having a precise function, shares some structural features with all other buildings with the same purpose [IC.14].

2 Long-Term Assistive and Collaborative Autonomous Mobile Robotics

One of the long-term applications of autonomous mobile robots is to assist in the execution of daily activities, both at home and in the workplace. The tasks that could already be performed by autonomous mobile robots are numerous, such as providing guidance and instructions in large scale environments as museums or hospitals, providing stimulation and support to elders living at home, or function as collaborative robots (cobots) in an office environment. However, the long-term deployment of an autonomous robotic platform in a real-world scenario presents several issues [IC.4] dealing both with core abilities of the robot, as mapping and localization [IC.5], [IC.10], and with advanced functionalities such as human-robot interaction [IC.12] [IC.3] [IC.3], task planning, and autonomous decision making. Moreover, the interaction of a robotic platform with IoT-based smart environments could increase the set of the possible application of robotic platforms [IC.4] [WS.3]. Up to now, a proper methodology for testing and assessing the correct long-term and large-scale functioning of such robots is still largely missing [JR.3]. Our research aims to address several of the current limitations of assistive and collaborative autonomous mobile robots, by analysing and evaluating the robot performances in new and different environments [IC.4] [IC.10] [JR.3], [IC.2], and by developing functionalities for assistive robots [WS.3] [IC.4] [IC.3].

Within the MoveCare project, we investigated how the creation of an Internet of Robotics Things (IoRT), based on the interplay between pervasive smart objects and autonomous robotic systems, can increase the performance and effectiveness of both and provide long-term support to the elder by creating novel innovative services. Moreover, we showed how long-term operational safety, reliability, and transparent human-robot interaction in long-term assistive robotics could be obtained by using a cloud-based architecture that allows us to monitor, to perform anomaly detection, and to *explain* the choices performed by the robot and the system in such context. Thanks to these contributions, we were able to collect data covering more than 1000 days of long-term and unsupervised use of socially assistive robots inside real elders’ houses, data that could be used to foster new developments. Three journal articles regarding those findings are in preparation.