Luigi Manfredi, PhD
M.Sc. Computer Eng. (2001), PhD (2008)
School of Medicine
Division of Medical Science and Technology
Institute for Medical Science and Technology (IMSaT)
University of Dundee
United Kingdom

Present position

Principal Investigator, Baxter Fellow **University of Dundee (UoD), UK**

My research is focused on smart endorobots for early cancer detection and treatment in the large bowel. I am an IEEE member and a member of the Commercial Team at School of Medicine, UoD. I am lecturer and supervisor of undergraduate and graduate Biomedical Engineering students.

I am author of about 50 peer review publications and inventor of 6 IPs (national and international). I have been supervisor of 20 MSc student, and 9 BSc student between 2012 and 2021.

Past positions

2018-20, Researcher **UoD, UK**

- Research on the design of devices for medical robots for colonoscopy and robots for surgical operations based on smart materials for flexible and compliant mechanisms (i.e. shape memory alloys – SMAs and soft polymers).
- Supervisor of undergraduate and graduate students.
- Lecturer on Biomedical Engineering (23 hours in 2019).

2011-18, Senior Post Doc **UoD, UK**

- Project coordinator in CODIR, ERC Advanced Grant, 3M EUR;
- Co-I in CARPE, ERC Proof of Concept Project;
- Design of a tethered snake-like colonoscopy robot using smart materials;
- Leading the camera design for the CODIR project in collaboration with Karl Storz;
- Submission of the scientific and financial reports to the European Commission in collaboration with the CODIR team and the University of Dundee's financial office;
- MSc and BSc first supervisor and lecturer activity in Biomedical Engineering (6 hours per year).

2008-11, Postdoctoral Fellow **Biorobotics Institute, Pisa, Italy**

- I worked in several FP7 projects on the biological hardware control for autonomous robots (LAMPETRA project, FP7, ICT, ANGELS, ICT, REPLICATOR, FET);
- I worked in close collaboration with the financial office to submit the financial reports to the European Commission;
- I represented the Institute in international project meetings in reporting the scientific results of the projects;
- Collaboration within the ARAKNES project (FP7, ICT) and contributed by implementing a real-time control for a single-port robot.

2005, Co-founder and Lead Engineer **ltd Company, Italy**

- Design and manufacturing of an electronic system and automation digital control, CE certification;
- CNC machines;
- Electronic Hardware and Software for Building Automation, CE certificated.

01-2002 / 04-2003, Junior Computer Engineer **INTEL LeA, Piombino, Italy**

- Implementation of real time software for wireless communication devices.

11-2001 / 12-2001, Bioengineering and Robotics Research Center "E. Piaggio", University of Pisa, Italy

- Junior Computer Engineer, real time software design

Education

2008 PhD in Biorobotics Science and Engineering, "Scuola Superiore Sant'Anna, Pisa" & "IMT Institute for Advanced Studies, Lucca", *"Study and Development of Adaptable Sensory-motor Control Schemes for Bio-inspired Robotic Systems",* Italy, 2005/2008;

2002 Enabled to the profession of Engineer by passing the Italian State Exam;

2001 MSc Computer Engineering, Pisa, Italy, 2001.

Academic Funding

2022 – PI EPSRC, Second call for transformative healthcare technologies, "SoftEn – Soft Endorobot for early cancer screening and treatment", £300,787, 1st October 2021-28th 31st December 2022

2021 – PI Scottish Enterprise, High-grow Spinout Program, Phase 1-Ext, £80,000, 1st September, 30th April 2022

2020 – PI: Scottish Enterprise, High-growth Spinout Programme, Phase 1, £ 83,700, 1st October 2020, 31st March 2021

2015-2016 - Co-Investigator: European Research Council (ERC), Proof of Concept (PoC), CARPE (Compliant Actuation Robotic Platform for Interventional Flexible Endoscopy, 1st July 2015 – 31st November 2016, 150,000 EUR.

2012 – Project Coordinator: Research, National Natural Science Foundation of China, Royal Society of Edinburgh, Project Coordinator of the Scotland Team, 2012-14, £ 12,000.

Awards

1. *Venture competition, Dundee, **2020**, "A soft disposable colonoscope for a painless and low-cost colonoscopy", Winner, £ 7,000*
2. *Surgical Robotic Challenge,* UK-RAS, Hamlyn Symposium, Imperial College, London, Short listed (final competition on the 22nd of June, **2019**)
3. *Enterprise Challenge, Dundee, **2019** "A soft disposable colonoscope for a painless and low-cost colonoscopy", Winner, £ 1,000*
4. *Venture competition, Dundee, **2019**, "A soft disposable colonoscope for a painless and low-cost colonoscopy", Runner-up*
5. *CARPE, Compliant Actuation Robotic Platform for flexible Endoscopy, Boston, USA, March 16-19, **2016**,* SAGES *Emerging technology award "Runner-up".*
6. *A miniaturized and distributed control system for a colonoscopy robotic platform*, Baltimore, USA, April 17-20, **2013**, SAGES Foundation Felicien M. Steichen Surgical Innovation Award.

Scientific interests

- Endorobotics for colorectal cancer screening and treatment.
- Advanced robotics system for surgery and endoscopy.
- Smart materials (Shape Memory Alloys, soft polymer) for mini actuators and sensors.
- Soft robotics.

Entrepreneurial and commercia training activities

1. Scottish Enterprise, High Grow Spin-out Program, **2020-21**.
2. Converge Challenge, **2020-21.**
3. BioCity Accelerator Programme: Pre-Accelerator Workshop, MediCity, Glasgow, 28-30, March **2020**.
4. BioCity Accelerator Programme, Glasgow, 18 May, **2020**, 8 Weeks.

5. Converge Challenge, 10 days, June **2020**.
6. Diversity on Spinouts, 4 weeks, November **2020**.
7. Scottish Enterprise, HGSP Training Programme, 5 weeks, November **2020**.

PhD external examiner

Mohammed Elsayed Abdelfattah Mohammed, University of Edinburgh, *'The Limpet: A Multi-Sensing Robotic Platform For Monitoring Offshore Energy Platforms'*, 18th September, 2019

Lecture activities

2020-21: 10 hours lecture in Biomechanics and 3 hours in Medical Robotics, at UoD;
2019-20: 23 hours lecture activity for the module “Biomedical Research Frontiers”, at UoD;
2018-19: 6 hours lecture activity for the module “Biomedical Research Frontiers”, at UoD;
2012-13, 2013-14, 2015-16, 2016-17: 6 hours lecture activity for the module “Medical Robotics” for the master’s degree in Biomedical Engineering , at UoD;
2006-07, 2007-08, 2008-09*:* 6 hours lecture activity for the module “Percezione Robotica” for the Master’s Degree in Biomedical Engineering at University of Pisa;
2006-07: 4 hours lecture activity for the First International Master in Robotics and Mechatronics of Scuola Superiore Sant’Anna, in collaboration with the Chongqing University, China.

Invited lectures and talks

1. Soft Robotics Laboratory, University of Bristol, A Soft Endorobot for Colonoscopy 10 July, 2020;
2. ESOF (EuroScience Open Forum) - The third millennium surgeon: a robot with artificial intelligence, “"Next generation of robotic active flexible colonoscopes", 9-14 July **2018**, Toulouse, France
3. “The next generation of motile robotic flexible endoscopy”, 6th World Congress of Endoscopic Surgery (WCES) jointly hosted by SAGES & CAGS, April 11-14, **2018** Washington State Convention Center, Seattle, WA, USA;
4. “The design and construction of a mini snake-like medical robot”, December 18th, **2017**, University of Exeter, UK;
5. “Next generation of active robotic flexible endoscopes”, The International Robotics Festival, September 7-13, **2017**, Pisa, Italy;
6. “The Design of a Miniaturised Compliant Medical Robot”, **IMechE** talk, November 10th, **2016**, Dundee, UK;
7. “Miniaturised system for bio-robotics”, Scientific session, Innovative devices, EAES, April 6-8, **2016**, Amsterdam, Netherland;
8. CARPE - Compliant Actuation Robotic Platform for Interventional Flexible Endoscopy, **Rethinking Robotics** Company, March 21st, **2016**, Boston, USA;
9. “Robotics for Surgery”, Summer School on Minimal Invasive Technology, **2012**, Shanghai Institute for Minimally Invasive Therapy, University of Shanghai for Science and Technology, China;
10. “Development of a modular underwater bio-inspired robot”, International Workshop on Bioinspired Robots, April 6-8, **2011**, Nantes, France.

Other scientific activities

- Member of the Technology Committee of the European Association of Endoscopic Surgery (EAES), **2021**

- Member of the Commercial Group at School of Medicine, University of Dundee (UoD), **2021**
- Member of the Equality Diversity and Inclusion (ED&I) Committee, at School of Medicine, UoD, **2021**
- Review Editor in Bionics and Biomimetics, Frontiers, **2020**
- Program committee in Actuator, International Conference and Exhibition on New Actuators and Drive Systems, Mannheim, June 16-18, **2020**;

Manuscripts' reviewer for:

- Science Robotics, IEEE *Transactions on Mechatronics, Bioinspired & Biomimetic, The International Journal of Medical Robotics and Computer Assisted Surgery, International Journal of Robotics & Automation, Journal of Engineering in Medicine, CSS transaction on Control System Technology, IEEE Access, SoftRobotics – SORO, International Journal of Robotics and Automation, Smart Materials and Structures, Medical Robotics, Bioinspired Biomimetics, Journal of Royal Society Interface.*

Scientific collaborations in international projects

1. CARPE (Compliant Actuation Robotic Platform for Flexible Endoscopy), HORIZON 2020, ERC PoC (2015-2016), Total Budget 150,000 EUR

   Role: Co-Investigator and Project Coordinator
2. CODIR (*Colonic Disease Investigation by Robotic Hydro-colonoscopy*) FP7 - ERC -Ideas - Project (2011-2016), Total Budget 3 M EUR

   Role: Project Coordinator
3. Lesion localization and navigation for minimal access robotically-assisted laparoscopic surgery, National Natural Science Foundation of China (2012-2014) Royal Society of Edinburgh, Total Budget 12,000 GBP

   Role: Project Coordinator of the Scotland Team
4. ARAKNES (Array of Robots Augmenting the KiNematics of Endoluminal Surgery), FP7 Project, EU/IST-2007-224565.

   Role: Postdoctoral Fellow (Hardware control validation and test).
5. LAMPETRA (*Life-like Artefact for Motor-Postural Experiments and Development of new Control Technologies inspired by Rapid Animal locomotion),* FP7 Project, ICT-2007.8.3 - FET proactive 3 "Bio-ICT convergence" (2008-2011), total budget 2,200,000 EUR

   Role: Postdoctoral Fellow (Hardware designer and Software development).
6. REPLICATOR (*Robotic Evolutionary Self-Programming and Self-Assembling Organism)*, FP7 - FET Project (2008-2013), total budget 7,060,000 EUR

   Role: Postdoctoral Fellow
7. ANGELS (*ANGuilliform robot with ELectric Sense*) FP7 - ICT- FET Project (2009-2012), total budget 4 M EUR.

   Role: Postdoctoral Fellow
8. EXPER (*Expected Perception sensory-motor scheme*), Toyota Europe, total budget 100,000 EUR

   Role: PhD Student (Implementation of the neural-network control for object identification for pre-shaping and grasping).
9. NEUROBOTICS (*The fusion of Neuroscience, Technology and Robotics*), FP6 - IST – FET, total budget 5,650,000 EUR.

   Role: PhD Student (Design and implementation of embedded digital control system for swimming eel like fish).

Most relevant publications

Book

L. Manfredi, Editor of *"Endorobotics: Design, R&D and Future Trends"*, Elsevier, ISBN 9780128217504, 1ST January, **2022**

Refereed Journal Articles

1. **L. Manfredi**, *"Endorobots for Colonoscopy: Design Challenges and Available Technologies",* Frontiers in Robotics and AI, Biomedical Robotics, Vol 8, doi: 10.3389/frobt.2021.705454, **2021**
2. S. Wen, Y. Zhao, H. Zhang, H. K. Lam, **L. Manfredi**, *"Joint optimization based on direct sparse stereo visual-inertial odometry"*, **2020**, Autonomous Robots, doi: 10.1007/s10514-019-09897-6
3. S. Wen, Y. Zhao, X. Yuan, Z. Wang, D. Zhang, **L. Manfredi***, "Path planning for active SLAM based on deep reinforcement learning under unknown environments"*, **2020**, Intelligent Service Robotics, doi: 10.1007/s11370-019-00310-w
4. **L. Manfredi**, E. Capoccia, G. Ciuti, and A. Cuschieri, *"A Soft Pneumatic Inchworm Double balloon (SPID) for colonoscopy"*, Scientific Report, 9(1), **2019**,doi:10.1038/s41598-019-47320-3
5. Y. Yan, Y. Liu, **L. Manfredi**, S. Prasad, *"Modelling of a Vibro-Impact Self-Propelled Capsule in the Small Intestine"*, Nonlinear Dynamics, Vol 1, **2019**, doi:10.1007/s11071-019-04779-z
6. **L. Manfredi**, F. Putzu, S. Guler, Y. Huan, A. Cuschieri *"4 DoFs Hollow Soft Pneumatic Actuator – HOSE"*, Material Research Express, 6(4), **2019,** doi:10.1088/2053-1591/aaebea.
7. ***L. Manfredi**, G. Natale, Review: New Robotic Technologies in Cancer Colon Screening, Clinical Cancer Drugs, **2018***
8. ***L. Manfredi**, A. Cuschieri, "Novel 2-DoFs miniature compliant joint as an integral actuating component for a snake-like robot",* Materials Vol. 11, Issue 10, **2018**, doi:10.3390/ma11102014
9. **L Manfredi,** Y. Huan, A. Cuschieri, *"Low power consumption mini rotary actuator with SMA wires",* Smart Materials and Structures, **2017**, Smart Materials and Structures, Sep 2017 115003 (13pp), doi:10.1088/1361-665X/aa8aa4
10. **L. Manfredi**, T. Assaf, S. Mintchev, S. Marrazza, L. Capantini, S. Orofino, L. Ascari, S. Grillner, P. Wallén, Ö. Ekeberg, C. Stefanini, P. Dario, *"A bioinspired autonomous swimming robot as a tool for studying goal-directed locomotion".* Biological Cybernetics 107(5): 513-527, **2013**, doi: 10.1007/s00422-013-0566-2
11. Z. Wang, I. Aarya, M. Gueorguieva, D. Liu, H. Luo, **L. Manfredi**, L. Wang, D. McLean, S. Coleman, S. Brown, A. Cuschieri, "Image-based 3D modeling and validation of radiofrequency interstitial tumor ablation using a tissue-mimicking breast phantom", Int J Comput Assist Radiol Surg. 2012 Nov;7(6):941-8, Epub **2012** Jun 12, doi: 10.1007/s11548-012-0769-3
12. S. Russo, K Harda, T. Ranzani, **L. Manfredi**, C. Stefanini, A. Menciassi, P. Dario*, "Design of a Robotic Module for Autonomous Exploration and Multimode Locomotion", IEEE/ASME* Transactions on Mechatronics, August **2012**, doi:10.1109/TMECH.2012.2212449;
13. C. Stefanini, S. Orofino, **L. Manfredi**, S. Mintchev, S. Marrazza, T. Assaf, L. Capantini, E. Sinibaldi, S. Grillner, P. Wallén, P. Dario, "A novel autonomous, bioinspired swimming robot developed by neuroscientists and bioengineers", Bioinspir Biomim. **2012** Jun;7(2), doi: 10.1088/1748-3182/7/2/025001;
14. D. Zambrano, E. Falotico, **L. Manfredi**, E. Laschi, *"A Model of the Smooth Pursuit Eye Movement with Prediction and Learning," Applied Bionics and Biomechanics, vol. 7, no. 2, pp. 109-118, **2010**. doi:10.1080/11762321003760944;*
15. C. Laschi, F. Patanè, E.S. Maini, **L. Manfredi**, G. Teti, L. Zollo, E. Guglielmelli, P. Dario, *"An Anthropomorphic Robotic Head for Investigating Gaze Control"*, Advanced Robotics, Vol.22, No.1, **2008**, pp. 57-89 (33), Published by VSP, an imprint of Brill, doi: 10.1163/156855308X291845;
16. E. S. Maini**, L. Manfredi**, C. Laschi, P. Dario, *"Bioinspired velocity control of fast gaze shifts on a robotic anthropomorphic head"*, Autonomous Robots, Vol. 25, No.1-2 August **2008**, pp. 37-58, Published by Springer Netherlands, doi:10.1007/s10514-007-9078-z.

Chapters in Books

1. **L. Manfredi**, E. S. Maini, C. Laschi *"Neurophysiological models Humanoid Robotics of gaze control in Humanoid Robotics"*, Humanoid Robots, 01/2009; ISBN: 978-953-7619-44-2, **2008**
2. N. Greggio, **L. Manfredi**, C. Laschi, P. Dario & M. C. Carrozza, *"Real-Time Least-Square Fitting of Ellipses Applied to the RobotCub Platform",* In: Simulation, Modeling and Programming for Autonomous Robots, S. Carpin, I. Noda, E. Pagello, M. Reggiani, O. Von Stryk, pp. 270-282, Vol. 5325 / **2008**, Springer Berlin / Heidelberg

International Conferences and Workshops

1. **L. Manfredi***, "A Compact Control Unit for a Pneumatic Soft Colonoscope",* ACTUATOR 2021, Online, 17-19 February **2021**
2. S. Wen, Y. Zhao, H. Yu, **L. Manfredi**, X. Li, S. Wang "Fuzzy Neural Network algorithm based on the delay compensation force/position control structure of a redundant actuation parallel robot", IEEE WRC SARA, Beijin China, 2019, 20-25 August, **2019**
3. S. Wen, X. Li, **L. Manfredi**, D. Zhang, N. Zhou, "Semantic Segmentation Using GAN and Weakly Supervised Based on Deep Transfer Learning", IROS, 4-8 November, **2019**
4. **L. Manfredi,** A. Cuschieri, *"A Wireless Compact Control Unit (WiCCU) for Untethered Pneumatic Soft Robots",* RoboSoft 2019, Seoul, Korea, 14-18 April, **2019**
5. **L. Manfredi,** L. Yue, J. Zhang, A. Cuschieri, *"A 4 DOFs variable stiffness soft module"*, Proc. of the IEEE RoboSoft 2018, Livorno, 24-28 April, **2018**
6. **L. Manfredi**, L. Yue, A. Cuschieri*, "A 3 DOFs Mini Variable Stiffness Soft Pneumatic Actuator",* Proc. of the IEEE Actuator 2018, Bremen, 25-27 June, **2018**
7. **L. Manfredi,** F. L. Velsink, H. Khan, A. Cuschieri, *"A variable impedance actuator based on shape memory alloy"*, ACTUATOR 2016, Bremen, 25-27 June, **2016**
8. H. Khan**, L Manfredi,** Y, Huan, F. L. Velsink, D. Dimitra, A. Cuschieri, *"Analysis of performance and energy efficiency of thin shape memory alloy wire-based actuators"*, ACTUATOR 2016, Bremen, 25-27 June, June 13-15, **2016**
9. **L. Manfredi,** H. Khan, A. Cuschieri, *CARPE, Compliant Actuation Robotic Platform for flexible Endoscopy,* SAGES, Boston, USA, March 16-19, **2016**
10. **L. Manfredi**, A. Cuschieri, *"A compliant active robotic platform for colonoscopy", April 15-18, Nashville, USA, **2015***
11. **L. Manfredi**, A. Cuschieri, *"Embedded, miniaturized and distributed control for a colonoscopy robotic platform",* Baltimore, *USA,* April 17-20, **2013**
12. **L. Manfredi**, A. Cuschieri, *"Augmented reality in minimal access surgery: comparative study of two second generation see-through head mounted displays for augmented reality"*, Baltimore, 17-20 April **2013**
13. **L. Manfredi**, S. C. Tapia, A. Cuschieri, "*Relevance of Sensory System Selection and Integration on Actuators Performance and Mechatronics Design", Bremen, June **2012***
14. C. Stefanini, S. Orofino, **L. Manfredi**, S. Mintchev, S. Marrazza, T. Assaf, L. Capantini, E. Sinibaldi, S. Grillner, P. Dario, *"A compliant bioinspired swimming robot with neuro-inspired control and autonomous behavior"*, IEEE International Conference on Robotics and Automation, ICRA, May 14-18, **2012**, River Centre, Saint Paul, Minnesota, USA
15. S. Mintchev, C. Stefanini, A. Girin, S. Marrazza, S. Orofino, V. Lebastard, **L. Manfredi**, P. Dario, F. Boyer *"An Underwater Reconfigurable Robot with Bioinspired Electric Sense"*, IEEE International Conference on Robotics and Automation, ICRA, May 14-18, **2012**, River Centre, Saint Paul, Minnesota, USA
16. S. Mintchev, S. Orofino, S. Marrazza**, L. Manfredi**, C. Stefanini, P. Dario, *"Development of a modular underwater bio-inspired robot*", International Workshop on bio-inspired robots, Nantes, France, 6-8 April **2011**
17. S. Mintchev, C. Stefanini, S. Marrazza, S. Orofino, **L. Manfredi**, and P. Dario, *"The first connection system for modular underwater bio-inspired robots"*, International Conference on Intelligent Robot and Systems, IROS, San Francisco, California, 25-30 September **2011**

18. *T. Schmickl, R. Thenius, J. Timmis, A. Tyrrell, J. Halloy, C. Stefanini,* ***L. Manfredi****, A. Campo, D. Sutantyo, S. Kernbach, " CoCoRo: The self-aware swarm of underwater robots"* IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS, **2011**
19. S. Kernbach, F. Schlachter, R. Humza, J. Liedke, S. Popesku, S. Russo, T. Ranzani, **L. Manfredi**, C. Stefanini, R. Matthias, Ch. Schwarzer, B. Girault, P. Alschbach, E. Meister, O. Scholz, *"Heterogeneity for Increasing Performance and Reliability of Self-Reconfigurable Multi-Robot Organisms"*, IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS, **2011**
20. **L. Manfredi**, E.S. Maini, P. Dario, C. Laschi, B. Girard, N. Tabareau, A. Berthoz, *"Implementation of a neurophysiological model of saccadic eye movements on an anthropomorphic robotic head",* Proc. of the IEEE-RAS International Conference on Humanoid Robots (HUMANOIDS06), Genova 4-6 Dec. **2006**

Patents

1. *A Soft Pneumatic Inchworm Double balloon (SPID) for colonoscopy,* **L. Manfredi** (filed in June **2019**)
2. *Stretchable sensors for soft devices,* **L. Manfredi**, (filed in February **2019**);
3. *Soft Pneumatic Variable Stiffness Tendon Actuator - SPeVaSTA*, **L. Manfredi,** application N. GB1713100.4 UK, **2017**;
4. *Active transmission system interface - ATSI,* **L. Manfredi**, application N. GB1708807.0 UK, **2017**;
5. *4 DOFs Hollow Soft Pneumatic Actuator- HOSE*, **L. Manfredi,** application N. GB 1617934.3, UK, **2016**, PCT/GB2017/053199, UK, **2017**;
6. *Compliant actuator for robotic application*, **L. Manfredi,** A. Cuschieri, application N. GB1407490.0 UK, **2014** (EP3137766 A1, US20170051729, WO2015166214 A1).