

## Enrico Franco, PhD, CEng

Mechanical Engineering Department,  
Imperial College London,  
UK, SW7 2AZ

City and Guilds Building, 708  
Email: [e.franco11@imperial.ac.uk](mailto:e.franco11@imperial.ac.uk)  
<https://www.imperial.ac.uk/people/e.franco11>

### Employment

**Research Associate** (Researcher Co-Investigator, EPSRC grant DEFCOBOT), IC, 2017 – present

- Co-authored the proposal (ranked second out of 18 in standard-grant panel – 02/08/2017)
- Investigated adaptive control of underactuated mechanical systems
- Designed controllers for soft robotic manipulators and for robotic needle insertion

**Research Associate**, Mechanical Engineering Department, IC, 2015 – 2017

- Led development of robot for Parkinson's rehabilitation (IC Dame Julia Higgins award)
- Led signal processing of motion sensors for stroke rehabilitation (NIHR i4i grant M-MARK)

**PhD candidate**, Mechanical Engineering Department, IC, 2011-2015

- Designed a fully functional needle-guiding robot for MRI-guided percutaneous intervention of liver tumours (NIHR i4i grant MRI-Guided Liver Ablation II-AR-1109-11011)
- Conducted pilot trials on patients in collaboration with St Mary's Hospital
- Investigated nonlinear adaptive control and teleoperation for robotic needle insertion

**Development engineer**, Parker Hannifin, Milton Keynes, UK, 2008-2011

- Design lead of pneumatic and hydraulic servo valves, 2010-2011
- Deputy manager of the Additive-manufacturing Department, 2009-2010
- Design lead and project manager of pneumatic motion control systems, 2008-2010

**Technical support engineer**, SolidWorks R&D Ltd, Cambridge, UK, 2005-2008

**Design engineer**, Arol spa, Canelli, Italy, 2004-2005

### Education

**PhD in medical robotics**, Mechanical Engineering Department, IC, awarded on 11/2015  
Thesis: "Robotic assistant for MRI-guided ablation of the liver"

**MSc in Mechanical engineering**, Politecnico di Torino, Italy, awarded on 03/2004  
Grade: 110/110 cum laude

### Funding and Awards

- **Research England GCRF 2019: £25,500**  
Co-author and research collaborator (not PI due to GCRF restrictions), Lead Applicant Prof Ferdinando Rodriguez y Baena
- **EPSRC Early Stage Impact Acceleration Account 2019: £14,030**  
Main author and named researcher (not PI due to EPSRC restrictions), PI Prof Alessandro Astolfi
- **EPSRC grant DEFCOBOT ([EP/R009708/1](https://www.imperial.ac.uk/people/e.franco11)), 2017-2019: £239,439**  
Main author and Researcher Co-Investigator (not PI due to EPSRC restrictions), PI Prof Ferdinando Rodriguez y Baena
- **IC Confidence-in-Concept award 2017: £48,000**  
Co-author and research collaborator, Lead Applicant Dr Ravi Vaidyanathan
- **IC Dame Julia Higgins Postdoc Collaborative Research Fund 2017: £3,500**  
Main author and Co-Investigator, co-applicants Dr Riccardo Secoli and Dr Javier Andreu
- **IC CDT for Neurotechnology 2016: 4-year studentship from 2017 to 2021**  
Co-author and assistant supervisor, Main supervisor Dr Ravi Vaidyanathan

- **Best conference paper award** IEEE/ASME 10th International Conference on Mechatronic and Embedded Systems and Applications (MESA), 2014

## **Collaborations**

- Prof A. Astolfi, Imperial College London  
Co-investigator in project DEFCOBOT (nonlinear adaptive control of soft robots)
- Dr T. Nanayakkara, Imperial College London  
Study of mechanisms with programmable stiffness
- Dr A. Donaire, The University of Newcastle, Australia  
Control of soft continuum manipulators (academic visitor in project DEFCOBOT)
- Prof W. Gedroyc, Imperial College NHS Trust  
Clinical collaborator in project DEFCOBOT (robotic assisted biopsy)  
Clinical lead in project "MRI-Guided Liver Ablation" (preclinical and clinical testing)
- Prof M. Stokes, Southampton University  
Clinical lead in project M-MARK (clinical validation of the sensor suite)

## **Invited Talks**

Invited talk in the Department of Aeronautics, Imperial College, November 2019  
Title: Passivity based control of flexible and soft robots

Invited talk at The University of Liverpool, June 2019  
Title: Soft robotics for healthy ageing

Invited talk at LSS SUPELEC, France, May 2019  
Title: New results on robust control of flexible and soft robots

Invited talk in the Morphological Computation and Learning Lab, IC, May 2018  
Title: Towards design for control of flexible robots

## **Supervision and Teaching Experience**

- Co-supervisor, GCRF Visiting Researchers, 2019  
Title: Design of affordable soft robotic manipulators for bronchoscopy
- Co-supervisor, MSc project, 2018-2019  
Title: Planning and motion control of a continuum soft robot
- Co-supervisor, final-year MEng project, 2018-2019  
Title: Advanced control for buckling avoidance in robotic needle insertion
- Assistant-supervisor, PhD, CDT in Neurotechnology, 2017-2021  
Title: Robots for Muscular rigidity assessment in Parkinson's patients
- Co-supervisor, UROP projects: 2016, 2017  
Title: Towards robot-assisted rehabilitation for Parkinson's Disease
- Lectures: ME4 Advanced Control, lectures on state feedback, 2019 and 2020
- Lectures: Topics in Control System (MSc Control Systems), lecture on modelling and control of soft robots, 2020
- Tutorials: ME1 Mechatronics, ME2 Mechatronics, and ME3 MSD, 2015 – 2020
- Graduate Teaching Assistant: ME2 Mechatronics Laboratory, 2011-2014

## **Professional Service**

Co-organiser of group talks and seminars: CAP group seminar series, MiM Lab seminar series.  
Reviewer for the following journals: IEEE/ASME TMECH; IJRR; ACSP; Mech. Mach. Theory.

## Publications

### Journal papers

1. **E. Franco**, A. Garriga Casanovas, “Energy Shaping Control of Soft Continuum Manipulators with in-plane Disturbances,” *Int. J. Robotics Research (IJRR)*, pp. 1-33, 2020 [In press].
2. **E. Franco**, “IDA-PBC with Adaptive Friction Compensation for Underactuated Mechanical Systems,” *Int. J. Control (TCON)*, pp. 1-29, 2019, ([doi](#)).
3. **E. Franco**, “Adaptive IDA-PBC for underactuated mechanical systems with constant disturbances,” *Int. J. Adapt. Control Signal Processing*, vol. 33, no. 1, pp. 1–15, 2019, ([doi](#)).
4. **E. Franco**, A. Astolfi, and F. Rodriguez y Baena, “Robust balancing control of flexible inverted-pendulum systems,” *Mech. Mach. Theory*, vol. 130, pp. 539–551, 2018, ([doi](#)).
5. **E. Franco**, “Immersion and invariance adaptive control for discrete-time systems in strict-feedback form with input delay and disturbances,” *Int. J. Adapt. Control Signal Processing (ACSP)*, vol. 32 no. 1, pp. 69–82, Jan 2018, ([doi](#)).
6. J.H. Burrige, A.C.W. Lee, R. Turk, M. Stokes, J. Whittall, R. Vaidyanathan, P. Clatworthy, A. Hughes, C. Meagher, **E. Franco**, L. Yardley, Telehealth, “Wearable Sensors, and the Internet: Will They Improve Stroke Outcomes Through Increased Intensity of Therapy, Motivation, and Adherence to Rehabilitation Programs?,” *J. Neurol. Phys. Ther.* vol. 41, 2017, ([doi](#)).
7. **E. Franco**, “Combined Adaptive and Predictive Control for a Teleoperation System with Force Disturbance and Input Delay,” *Front. Robot. AI*. vol. 3, 2016, ([doi](#)).
8. **E. Franco**, M. Ristic, M. Rea, and W. M. W. Gedroyc, “Robot-assistant for MRI-guided liver ablation: A pilot study,” *Med. Physics*, vol. 43, no. 10, pp. 5347–5356, Oct. 2016, ([doi](#)).
9. **E. Franco**, M. Rea, W. Gedroyc, and M. Ristic, “Control of a Master-Slave Pneumatic System for Teleoperated Needle Insertion in MRI,” *IEEE/ASME Trans. Mechatronics (TMECH)*, vol. 21, no. 5, pp. 2595–2600, Oct. 2016, ([doi](#)).
10. **E. Franco**, D. Brujic, M. Rea, W. M. Gedroyc, and M. Ristic, “Needle-Guiding Robot for Laser Ablation of Liver Tumors Under MRI Guidance,” *IEEE/ASME Trans. Mechatronics (TMECH)*, vol. 21, no. 2, pp. 931–944, Apr. 2016, ([doi](#)).
11. **E. Franco**, M. Aurisicchio, and M. Ristic, “Design and control of 3-DOF needle positioner for MRI-guided laser ablation of liver tumours,” *Int. J. Biomechatronics Biomed. Robot.*, vol. 3, no. 3, p. 145, 2015, ([doi](#)).

### Conference papers

1. **E. Franco**, A. Garriga Casanovas, F. Rodriguez y Baena, A. Astolfi “Model based adaptive control for a soft robotic manipulator,” *2019 IEEE Conference on Decision and Control*, ([link](#)).
2. **E. Franco**, T. Brown, “Energy-shaping Control for Robotic Needle Insertion,” *2019 International Conference on System Theory, Control and Computing*, Romania, ([doi](#)).
3. **E. Franco**, “Energy-based Design of Elastic Joints for Inverted Pendulum Systems with Input Saturation,” *27th Mediterranean Conference on Control and Automation*, Israel, 2019 ([doi](#)).
4. **E. Franco**, “Discrete-time IDA-PBC for underactuated mechanical systems with input-delay and matched disturbances,” in *26th Mediterranean Conference on Control and Automation*, pp. 747-752, Croatia, 2018, ([doi](#)).
5. **E. Franco** and M. Ristic, “Adaptive control of a master-slave system for teleoperated needle insertion under MRI-guidance,” in *23rd Mediterranean Conference on Control and Automation*, pp. 61–67, Spain, 2015, ([doi](#)).
6. **E. Franco** and M. Ristic, “Design and control of needle positioner for MRI-guided laser ablation of the liver,” in *IEEE/ASME 10th International Conference on Mechatronic and Embedded Systems and Applications*, pp. 1–6, Italy, 2014, ([doi](#)).
7. **E. Franco** and M. Ristic, “Time delay controller for the position control of a MRI-compatible pneumatic actuation with long supply lines,” in *2014 IEEE/ASME International Conference on Advanced Intelligent Mechatronics*, pp. 683–689, France, 2014, ([doi](#)).