

DR JUNKE YAO

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Postdoc with expertise and interest in developing multi-states soft robotics and Aorta phantoms for cardiovascular interventions and multiphysics computational simulation and modelling for medical devices (e.g., FEA, FSI).

HIGHLIGHTS AND ACHIEVEMENTS

- Five first-author peer-reviewed publications spanning soft robotics, cardiovascular biomechanics and medical-device modelling, with work published in *IEEE Robotics and Automation Letters*, *IEEE Transactions on Biomedical Engineering*, and *IEEE Transactions on Medical Robotics and Bionics*, and presented at major international conferences including IEEE RoboSoft, IEEE IROS, IEEE EMBC, the Hamlyn Symposium on Medical Robotics and the World Congress of Biomechanics.
- Developed a multidisciplinary research profile bridging **programmable mechanical structures, soft robotics and cardiovascular engineering**, supported by expertise in nonlinear finite-element modelling, fluid–structure interaction, rapid prototyping and experimental validation, through research and training at Oxford, King’s College London, UCL and Imperial College London.
- Academic training includes a PhD in Medical Robotics from UCL, an MSc in Human and Biological Robotics with Distinction from Imperial College London, and a BEng with First-Class Honours from the University of Glasgow. Recipient of the China National Scholarship and the UESTC–University of Glasgow Dean’s Scholarship, ranked 1st among peers.

HIGHER EDUCATION

University College London

Jan. 2020 – Jul. 2024

Ph.D. in medical robotics, Department of Mechanical Engineering

- **Project:** Soft robotic balloon catheter used for cardiovascular interventions.
- **Supervisors:** **Prof. Helge A Wurdemann**, (Head of Soft Haptics and Robotics Lab), and **Prof. Gaetano Burriesci** (Head of UCL Cardiovascular Engineering Laboratory and Group Leader in Bioengineering at Fondazione Ri.MED)
- **Responsibility:** Senior researcher supervises experiments with commercial pulse duplicator machine and manages 3D printing processes
- **Achievements:** Develop a robotic device and finite element models to enhance balloon catheter dilatation technique during cardiovascular interventions such as TAVI and BAV, results published in **five peer-review papers**.

Imperial College London

Sep. 2018 – Sep. 2019

M.Sc. Human and Biological Robotics, Department of Bioengineering

Distinction

- **MSc Final Project:** Exploring Human Perception in Physical Examinations.
- **Supervisor:** **Prof. Fernando Bello**, (Director of the Centre for Engagement and Simulation Science and Academic Co-director of Imperial’s MSc in Surgical Innovation).
- **Achievements:** Graduate with **Distinction MSc project** with final mark 76% on a Virtual-Reality haptics device, resulting in the submission of a paper to IEEE Transactions on Haptics and the World Haptics Symposium 2020.

University of Glasgow (UoG)

Sep. 2014 – Jun. 2018

B.Eng Electronics and Electrical Engineering

Honours of the First class

- **BEng Final Project:** Smart Stent Device for Restenosis Detection.
- **Supervisor:** **Prof. Steven Neale**, (Head of Micromanipulation Research Group at UoG).
- **Achievements:** **Graduated with Honours**, and final year individual project with **A grade** on heart stent.

University of Electronics Science and Technology of China (UESTC)

Sep. 2014 – Jun. 2018

B.S. Electronics and Information Engineering

Double bachelor’s degree

- Joint programme with the University of Glasgow.
- **Achievements:** Received the China National Scholarship (**top 10%**) and the Dean’s Scholarship (**ranking #1** among peers), while completing a Sino-foreign education project to earn a double bachelor’s degree.

RESEARCH EXPERIENCES

Metamaterial Reconfigurable Soft Robotics

Jul. 2024 – present

- **Innovative Design:** Leading development of **multi-stable modular robots** and **magnetically-driven robots** that achieve reconfigurable shape-morphing.
- **Programmable Metamaterials:** Designed and optimised metamaterial unit-cells to realise programmable responses and control-efficient mechanical switching between multiple stable states via reduced input.
- **Experimental Validation:** Combined FEA-based geometry optimisation with rapid prototyping (laser-cut elastomers, 3D-printed moulds) and magnetic actuation to validate deformation and control precision.

Advancing Cardiovascular Intervention Devices with Robotic Assistance

Feb. 2020 – Jun. 2024

- **Outstanding Contributions:** Throughout the project, have authored **three published journal papers**, one full-length conference paper, and delivered five presentations at IROS, HSMR, WCB, and EMBC.
- **Numerical Modelling:** Built **finite element models** of the device and aorta are used to analyse the folded balloon catheter **inflation procedure** and Fluid-Structure Interaction between the device and pulsating fluid environment, published in **IEEE EMBC 2022** and presented at **WCB 2022**.
- **Innovative Approach:** Developed an intra-operative sizing technique utilizing balloon catheters to enhance the accuracy of prosthesis heart valve selection by estimating the dimensions and geometry of the aortic annulus. Related results were published in **IEEE-TBME 2023** and presented at the **Hamlyn Symposium 2023**.
- **Enhanced Intervention Techniques:** Implemented synchronised balloon inflation techniques, particularly effective under slow heart rates, minimising the need for additional intervention techniques (e.g., Rapid Ventricular Pacing) and showcasing superior performance in dilatation with calcified aortic root phantoms. The related results were published in **IEEE-TMRB 2024**, **IEEE RA-L 2025**, and presented in **IEEE IROS 2025**.

Exploring Human Perception in Physical Examinations (Graduate Individual Project)

Mar. 2019 – Sep. 2019

- **Academic Distinction:** Attained a **Distinction mark (76%)** with a manuscript submitted to **IEEE Transactions on Haptics (ToH)** and the **IEEE Haptics Symposium 2020 (HAPTICS)**.
- **Innovative Research:** Investigated human perception during physical examinations to enhance teaching simulators and recreated virtual haptic environments on Unity for experimental purposes.
- **Clinical Insights:** Conducted experiments yielding valuable insights from both clinical and non-clinical participants, particularly in simulated Digital Rectal Examinations.

Human-Centered Assistive and Rehabilitation Devices

Mar. 2019

- **Award-Winning Innovation:** Recognized for developing the best innovative device at Imperial College London among more than 10 groups.
- **Cerebral Palsy Assistance:** Engineered a device aimed at improving lower-limb mobility in cerebral palsy children by creating a game for hip joint rotation training through an engaging Unity interface.
- **Technical Leadership:** Led electronics design and facilitated communication between electronics components with the Unity environment.

TEACHING EXPERIENCE

Senior Teaching Assistant at UCL | *Mathematical Modelling & Analysis*

Sep. 2023 – June. 2024

- Held tutorial and workshop session, and coursework.
- Guided the exam preparation and arrangement.

Teaching Assistant in UCL | *Mechanical Engineering Practical Skills*

Sep. 2022 – Jun. 2023

- Lecture in Python for the first year undergraduate students.
- Lab session in basic mechanical energy balance experiments.

Teaching Assistant in UCL | *Advanced Thermodynamics and Fluid Dynamics*

Jun. 2020 – Sep. 2020

- Coursework and alternative assessment marking with detailed feedback.

PEER-REVIEWED LIST OF PUBLICATIONS

- **J. Yao**, Y. Wang, A. Rezanejad and A. E. Forte, "Hybrid Jamming–Magnetic Reconfigurable Soft Structures for Shape Morphing Robotics", in *IEEE RoboSoft 2026*, pp.865–870.
- **J. Yao**, X. Pi, G. M. Bosi, G. Burriesci and H. Wurdemann, "Synchronous Inflation of a Valvuloplasty Balloon Catheter with Heart Rate: In-vitro Evaluation in Terms of Dilatation Performance," in **IEEE Robotics and Automation Letters**, vol. 10, no. 2, pp. 1114-1121, 2025.
- A. Rezanejad, M. Mousa, Y. Wang, M. Alderstein, **J. Yao**, and A. E. Forte, "Vacuum–Laser Fabrication of Programmable Soft Actuators", in **Advanced Science** (2026): e22500.
- X. Pi, **J. Yao**, Benjamin Adams, Antonia Gerontati, and H. Wurdemann, "Growing manipulators through feeding material outside-in: Inversion robots," in *2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Hang Zhou, China.
- **J. Yao**, J. Salmons-Smith, G. M. Bosi, G. Burriesci and H. Wurdemann, "Finite Element and Fluid-Structure Interaction Modeling of a Balloon Catheter," in **IEEE Transactions on Medical Robotics and Bionics**, vol. 6, no. 1, pp. 68-72, 2024.
- **J. Yao**, G. M. Bosi, A. Palombi, G. Burriesci and H. Wurdemann, "Compliant Aortic Annulus Sizing With Different Elliptical Ratios Through a Valvuloplasty Balloon Catheter," in **IEEE Transactions on Biomedical Engineering**, vol. 70, no. 12, pp. 3469-3479, 2023.
- **J. Yao**, G. M. Bosi, G. Burriesci and H. Wurdemann, "Valvuloplasty Balloon Catheter Sizing Approach for Calcified Aortic Valve with Different Annulus Ratios", *The 15th Hamlyn Symposium on Medical Robotics, London, UK, 2023*.
- **J. Yao**, G. M. Bosi, G. Burriesci and H. Wurdemann, "Computational Analysis of Balloon Catheter Behaviour at Variable Inflation Levels," *2022 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, Glasgow, UK, 2022, pp. 3015-3019.
- **J. Yao**, G. M. Bosi, G. Burriesci and H. Wurdemann, "Understanding Different Inflated Balloon Catheter Behaviours via Computational Modelling", *The 14th Hamlyn Symposium on Medical Robotics, London, UK, 2022*.
- **J. Yao**, G. M. Bosi, G. Burriesci and H. Wurdemann, "Fluid-Structure Interaction Analysis of a Valvuloplasty Balloon Catheter", *9th World Congress of Biomechanics, Taipei, China, 2022*.

AWARD AND SCHOLARSHIP

2019 The Best Innovative Rehabilitation Device at Imperial College London

2015 China National Scholarship at UESTC (top 10%)

2014 UESTC-UoG Dean's Scholarship (top 5%, ranking 1st)

ACADEMIC SERVICE

Journal Reviewer 2023 – Present

- IEEE Robotics and Automation Letters (RA-L) & IRBM & Medical Engineering&Physics

Conference Reviewer 2023 – Present

- Hamlyn Symposium on Medical Robotics (HSMR) & IEEE-RAS International Conference on Soft Robotics

TECHNICAL SKILLS

- **Computational Modelling and Simulation (ANSYS, LS-DYNA, Hypermesh):**
 - Constructed finite element models of the balloon catheter and aortic valves in Hypermesh. Performed structural simulations to validate the model using ANSYS.
 - Implemented the Arbitrary Lagrangian Eulerian method to solve fluid-structure interaction between the device, aortic valve and blood flow using LS-DYNA.
- **Programming languages such as Python and MATLAB**
 - Applied OpenCV via Python for image processing and objective tracking for tracking the balloon movement under the pulsating fluidic environment.
 - Developed a mathematical model of the balloon and implemented a sizing algorithm via MATLAB to ascertain the aortic annular diameter.