Zerui Wang

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Education

Ph.D. Degree, Mechanical & Automation Engineering, The Chinese Univ. of Hong Kong, 2013-2017

Cumulative GPA: 3.97/4

Research interests:

Safety mechanism design in robotic surgery;

Visual servoing in medical robotics.

Visiting Student, Computer Science, The Johns Hopkins University, 2016-2017

Research interests:

Improvement of dvrk-ros and cisst-saw software environment in terms of trajectory generator, MatLab wrapper, joint torque control interface, etc;

Image-based trajectory tracking control;

Vision-based calibration of dual RCM-based robot arms;

Universal soft object/tool manipulation w/o constraints.

Exchange in Europe, Summer 2012

TU Delft, VUB, U-PSUD, ECP, ISAE

Most selective elite delegation among students in Beihang University (top 0.75%)

B.Eng. Degree, Quality and Reliability Engineering, Beihang University, 2009-2013

Overall GPA: 3.84/4 (90.04/100), rank **1st** in School of Reliability & System Engineering

Senior high school student, Urumqi No.1 Senior High School, 2006-2009

Top 0.18% in the National College Entrance Examination

The 1st Prize in National Olympiad in Informatics

The 2nd Prize in Chinese Physics Olympiad

Honors & Awards

- Best Innovation Prize in Surgical Robot Challenge of Hamlyn Symposium   Jul. 2017

- Overseas Research Attachment Programme Scholarship   Oct. 2015

- Reaching Out Award (Government Scholarship)   Jun. 2015

- Awardee of Hong Kong PhD Fellowship (Government Scholarship)   Aug. 2013

- Champion of Innovative Underwater Robot Design RoboCup Open (China)   Nov. 2012

- The 2nd-Prize in National University Mechanical Innovation Competition (10%)   Jul. 2012

- The 2nd-Prize in National Undergraduate Physics Competition (7.5%)   Dec. 2010

- National Scholarship for University Students (2.6%)   Nov. 2010

- Excellent Students Awards of Beijing (1.1%)   Nov. 2011
- Elite Student of Beihang University (3%)   Nov. 2011
- Outstanding Student Award, *Yang Weimin* Special Scholarship (0.8%)   Mar. 2012
- The 2nd-Prize Scholarship of Academic Contest (3%)   Dec. 2011
- The 1st-Prize Scholarship of Science and Engineering Contest (7%)   2010-2012
- The 1st-Prize Scholarship of Academic Performance (3%)   2010-2012

Projects

Postgraduate

Vision-based deformable object/tool manipulation using the da Vinci Research Kit (DVRK) and the cisst/SAW Software Environment, Computer Integrated Interventional Systems Laboratory, Johns Hopkins University, Visiting Student. (Jan. 2016 - April. 2017)
Supervisor: *Prof. Yunhui Liu, Prof. Peter Kazanzides, Prof. Russell H. Taylor*

  Improvement of dvrk-ros and cisst-saw software environment in terms of trajectory generator, MatLab wrapper, joint torque control interface, etc;

  Image-based trajectory tracking control of 4-DoF laparoscopic instruments using dVRK;

  Vision-based calibration of dual RCM-based robot arms using dVRK;

  Autonomous Model-Less Deformable Object Manipulation in a Constrained and Disturbed Environment;

  Vision-Based Autonomous Needle Insertion Using Collaborative Manipulation of Unmodeled Deformable Tissues;

Uterus Manipulator for Hysterectomy, Medical Robotics Laboratory, The Chinese University of Hong Kong, Ph.D. Candidate. (since Aug. 2014)
Supervisor: *Prof. Yunhui Liu*

  Assist with the mechanical structure optimization of the endoscope manipulator (3rd version);

  Assist with system assembly (3rd version).

Endoscope Manipulator for Sinus Surgery, Medical Robotics Laboratory, The Chinese University of Hong Kong, Ph.D. Candidate. (since Oct. 2013)
Supervisor: *Prof. Yunhui Liu*

  Assist with the mechanical structure optimization of the endoscope manipulator (2nd & 3rd version);

  Build the control system (hardware & software) for the endoscope manipulator (3rd version).

Compliant Safe Robot Joint, Medical Robotics Laboratory, The Chinese University of Hong Kong, Ph.D. Candidate. (Aug. 2013 – Dec. 2015)
Supervisor: *Prof. Yunhui Liu*

  Mechanical design of the compliant safe robot joint;

  Structure optimization by analyzing how the key parameters affect the joint's performance (torque threshold, stiffness under compliant state, etc.);

  Design the torque regulation controller and the trajectory tracking controller;

  Conduct the collision experiments with human to validate the performance of the joint.

Undergraduate

Bio-inspired Autonomous Robotic Fish, Intelligence Control Laboratory, Peking University, RA. (Jun. 2012 – Jun. 2013)
Advisor: *Prof. Guangming Xie*

Mechanical design of the new version biomimetic fish robot with SolidWorks;

Design the pressure sensor unit;

Complete online Particle Swarm Optimization (PSO) and the pectoral fin optimization experiment;

Analyze the motion and build the simplified kinetics model of the bio-inspired autonomous robotic fish.

Multifunctional Wall-Climbing Platform, Innovation Internship Center, Beihang University, RA, Key team member. (Sep. 2011 – Jul.2012)
Advisor: *Prof. Guiping Jing*

Participate in function design, employ innovative approach of Detachable Accessory to make the platform able to replace human in special and dangerous tasks by assembling it with different specialized devices;

Develop detailed design based on series of feasibility verification experiments such as testing the performance of different distributions of the vanes in centrifuge and testing the mechanical strength of different structures of the vacuum chamber frame;

Determine the size, weight and size requirements of each part based on WBS method, establish the platform's digital mock-up with SolidWorks, finish the progress of manufacturing, processing and assembling all our own.

Interdisciplinary Modeling Program, School of Mathematics & System Engineering, Beihang University, RA, Team leader. (Nov. 2009 – Mar. 2012)
Advisor: *Prof. Xiaobing Ma*

Optimization Scheme of Classroom Light Placement, build physical model of the relationship between placement parameters and feelings of human eyes and identify optimal parameters' value using numeric method (Matlab & C++);

Arrangement of Mining Trucks in Quarry, use both Genetic Algorithm and improved Greedy Algorithm to solve the problem of Chinese Postman Problem and compare the performances of the two algorithms;

Estimation of Epidemic SARS Spread, build the mathematical model by a series of differential equations according to the classical SIR model, estimate the parameters of the model by maximum likelihood estimate method and carry out sensitivity analysis of the model.

Publications

Journal Articles

1. **Z. Wang***, F. Alambeigi*, Y.-H. Liu, R. H. Taylor, and M. Armand, Autonomous Model-Less Deformable Object Manipulation in a Constrained and Disturbed Environment. *Int. J. Rob. Res., under review*, 2017.

2. F. Alambeigi*, **Z. Wang***, Y.-H. Liu, R. H. Taylor, and M. Armand, Toward Semi-Autonomous Laparoscopic Cryoablation of Kidney Tumors Using Collaborative Model-Independent Deformable Tissue Manipulation Technique. *Ann. Biomed. Eng., under review*, 2017.

3. F. Zhong, **Z. Wang**, and Y.-H. Liu, Collaborative Needle Manipulation with Tissue Targeting for Execution of Autonomous Suturing in Robotic Surgery. *IEEE Rob. Autom. Lett., under review*, 2017.

4. **Z. Wang**, Z. Liu, Q. Ma, A. Cheng, Y.-H. Liu, S. Kim, A. Deguet, A. Reiter, P. Kazanzides, and R.H. Taylor, Vision-Based Calibration of Dual RCM-Based Robot Arms in Human-Robot Collaborative Minimally Invasive Surgery. *IEEE Rob. Autom. Lett., accepted*, 2017.

5. **Z. Wang**, S.C. Lee, F. Zhong, D. Navarro-Alarcon, Y.-H. Liu, A. Deguet, P. Kazanzides and R.H. Taylor, Image Based Trajectory Tracking of 4-DoF Laparoscopic Instruments Using a Rotation Distinguishing Marker. *IEEE Rob. Autom. Lett.*, vol. 2, no. 3, pp. 1586-1592, March 2017.

6. D. Navarro-Alarcon, H.M. Yip, **Z. Wang**, Y.-H. Liu, F. Zhong, T. Zhang and P. Li, Automatic 3D Manipulation of Soft Objects by Robotic Arms with Adaptive Deformation Model. *IEEE Trans. Rob.*, vol. 32, no. 2, pp. 429-441, April 2016.

7. **Z. Wang**, H.M. Yip, D. Navarro-Alarcon, P. Li, Y.-H. Liu, D. Sun, H. Wang and T.H. Cheung, Design of a Novel Compliant Safe Robot Joint with Multiple Working States. *IEEE/ASME Trans. Mechatron.*, vol21, no. 2, pp. 1193-1198, April 2016.

Conference Proceedings

1. **Z. Wang**, X. Li, D. Navarro-Alarcon, and Y.-H. Liu, A Unified Adaptive Controller for Contacting and Manipulating Deformable Objects Using Uncalibrated Cameras. *IEEE Int. Conf. Robotics and Automation (ICRA), under review*, 2017.

2. C. Sui, **Z. Wang**, and Y.-H. Liu, A 3D Laparoscopic Imaging System Based on Stereo-Photogrammetry with Random Patterns. *IEEE Int. Conf. Robotics and Automation (ICRA), under review*, 2017.

3. **Z. Wang**, Z. Liu, Q. Ma, A. Cheng, Y.-H. Liu, S. Kim, A. Deguet, A. Reiter, P. Kazanzides, and R.H. Taylor, Vision-Based Calibration of Dual RCM-Based Robot Arms in Human-Robot Collaborative Minimally Invasive Surgery. *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS), accepted*, 2017.

4. F. Alambeigi*, **Z. Wang***, Y.-H. Liu, M. Armand, and R. H. Taylor, Smart Autonomous Unknown Deformable Object Manipulation Using the da Vinci research Kit: from Soft Tissues to Continuum Robots Manipulation. *Hamlyn Symposium Surgical Robot Challenge*, **Best Innovation Prize** 2017.

5. F. Zhong, D. Navarro-Alarcon, **Z. Wang**, Y.-H. Liu, T. Zhang, and H.M. Yip, Adaptive 3D Pose Computation of Suturing Needle Using Constraints From Static Monocular Image Feedback. *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pp. 2153-0866, 2016.

6. D. Navarro-Alarcon, **Z. Wang**, H.M. Yip, Y.-H. Liu, F. Zhong and Tianxue Zhang, Robust Image-based Computation of the 3D Position of Laparoscopic Instruments and its Application to Image-guided Manipulation. *IEEE Int. Conf. Robotics and Automation (ICRA)*, pp. 4115-4121, 2016.

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* represents co-first author.

7. Y. Lu, Y.-H. Liu, **Z. Wang** and F. Zheng, Lens-free and portable quantitative phase microscope using a dual-pinhole aperture. *IEEE Int. Sym. Optomechatronic Technologies (ISOT)*, pp. 04002 p1-p4, 2015.

8. H.M. Yip, **Z. Wang**, D. Navarro-Alarcon, P. Li and Y.-H. Liu, A New Robotic Uterine Positioner for Laparoscopic Hysterectomy with Passive Safety Mechanisms: Design and Experiments. *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pp. 3188-3194, 2015.

9. D. Navarro-Alarcon, H.M. Yip, **Z. Wang**, Y.-H. Liu, W. Lin and P. Li, Gradient Descent Adaptive Methods to Automatically Position 3-DOF RCM Mechanisms with a Monocular Camera. *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pp. 5403-5409, 2015.

10. W. Lin, D. Navarro-Alarcon, P. Li, **Z. Wang**, H.M. Yip and Y.-H. Liu, A New Robotic Uterine Positioner for Laparoscopic Hysterectomy with Passive Safety Mechanisms: Design and Experiments. *IEEE/RSJ Int. Conf. Intelligent Robots and Systems (IROS)*, pp. 811-816, 2015.

11. **Z. Wang**, P. Li, D. Navarro-Alarcon, H.M. Yip, Y.-H. Liu, W. Lin and L. Li, Design and Control of a Novel Multi-state Compliant Safe Joint for Robotic Surgery. *IEEE Int. Conf. Robotics and Automation (ICRA)*, pp. 1023-1028, 2015.

12. D. Navarro-Alarcon, **Z. Wang**, H.M. Yip, Y. Liu, P. Li and W. Lin, A Method to Regulate the Torque of Flexible-joint Manipulators with Velocity Control Inputs. *IEEE Int. Conf. Robotics and Biomimetics (ROBIO)*, pp. 2437-2442, 2014.

13. H.M. Yip, P. Li, D. Navarro-Alarcon, **Z. Wang** and Y.-H. Liu, A new circular-guided remote center of motion mechanism for assistive surgical robots. *IEEE Int. Conf. Robotics and Biomimetics (ROBIO)*, pp. 217-222, 2014.

Patent

1. P. Li, **Z. Wang**, Y.-H. Liu. Compliant Safe Joint and Manufacturing Method Thereof. U.S. Patent App. 15/089,156, U.S. Patent No. US20160298696, 2016.