

# Contents

## Part I: Intelligent Techniques for Robotic Welding

|  |           |
|--|-----------|
| <b>Research Evolution on Intelligentized Technologies for Robotic Welding at SJTU .....</b>                          | <b>3</b>  |
| <i>S.B. Chen</i>   |           |
| <b>Image Processing for Automated Robotic Welding.....</b>   | <b>15</b> |
| <i>Peter Seyffarth, Rainer Gaede</i>   |           |
| <b>Automatic Seam Detection and Path Planning in Robotic Welding .....</b>   | <b>23</b> |
| <i>Kevin Micallef, Gu Fang, Mitchell Dinham</i>  |           |
| <b>Error Compensation and Calibration of Inter-section Line Welding Robot Based on a Wavelet Neural Network.....</b> | <b>33</b> |
| <i>Su Wang, Xingang Miao, Yuan Yang, Xingai Peng</i>   |           |
| <b>Autonomous Seam Acquisition and Tracking for Robotic Welding Based on Passive Vision .....</b>                    | <b>41</b> |
| <i>Shanchun Wei, Meng Kong, Tao Lin, Shanben Chen</i>  |           |
| <b>A Framework of Intelligent Remanufacturing System Based on Robotic Arc Welding .....</b>                          | <b>49</b> |
| <i>Ziqiang Yin, Guangjun Zhang, Hongming Gao, Huihui Zhao, Lin Wu</i>  |           |
| <b>A Fast GPI Line Detection Method for Robot Seam Tracking .....</b>  | <b>57</b> |
| <i>Bowen Li, Shengqi Tan, Wenzeng Zhang</i>  |           |
| <b>Mechanism Design and Kinematics Modeling of Irregular Cross-Section Pipeline Welding Robot .....</b>              | <b>65</b> |
| <i>Xinghua Tao, Hongwu Zhu, Lili Xu</i>  |           |

|   |            |
|---|------------|
| <b>Combined Planning between Welding Pose and Welding Parameters for an Arc Welding Robot .....</b>         | <b>73</b>  |
| <i>Huanming Chen, Yichen Meng, Xiaofeng Wang</i>  |            |
| <b>Optimal Digital Filtering for Tremor Suppression in a Master-Slave Robot Remote Welding System .....</b> | <b>81</b>  |
| <i>Hongtang Chen, Haichao Li, Hongming Gao, Lin Wu, Guangjun Zhang</i>                                      |            |
| <b>Coordinated Motion of Different Weld Robots Based on User Coordinates .....</b>                          | <b>87</b>  |
| <i>Huajun Zhang, Chunbo Cai, Guangjun Zhang, Daming Shen</i>  |            |
| <b>Research on Information Transmission of a Welding Robot Based on Network .....</b>                       | <b>97</b>  |
| <i>H.B. Wang, G.H. Ma, D.H. Liu, B.Z. Du</i>  |            |
| <b>Survey on Modeling and Controlling of Welding Robot Systems Based on Multi-agent .....</b>               | <b>107</b> |
| <i>Chengdong Yang, Shanben Chen</i>   |            |
| <b>Research on the Robotic Arc Welding of a Five-Port Connector .....</b>                                   | <b>115</b> |
| <i>Jiyong Zhong, Huabin Chen, Shanben Chen</i>  |            |
| <b>Mixed Logical Dynamical Model for Robotic Welding System .....</b>                                       | <b>123</b> |
| <i>Hongbo Ma, Shanben Chen</i>  |            |
| <br><b>Part II: Sensing of Arc Welding Processing</b>   |            |
| <b>A Method of Seam Tracking Based on Passive Vision .....</b>  | <b>131</b> |
| <i>Long Xue, Lili Xu, Yong Zou</i>  |            |
| <b>Research on a Trilines Laser Vision Sensor for Seam Tracking in Welding .....</b>                        | <b>139</b> |
| <i>Zengwen Xiao</i>   |            |
| <b>An Optimal Design of Multifunctional Vision Sensor System for Welding Robot .....</b>                    | <b>145</b> |
| <i>Yanling Xu, Xiangfeng Kong, Shanben Chen</i>   |            |
| <b>Wire Extension Control Based on Vision Sensing in Pulsed MIG Welding of Aluminum Alloy .....</b>         | <b>153</b> |
| <i>Lihui Lu, Ding Fan, Jiankang Huang, Jiawei Fan, Yu Shi</i>   |            |

|  |     |
|--|-----|
| <b>Research on Track Fitting of Big Frame Intersection Line<br/>Seams</b> .....                                  | 161 |
| <i>Xingang Miao, Su Wang, Xiaohui Li, Benting Wan</i>  |     |
| <b>A Hybrid Approach for Robust Corner Matching</b> .....  | 169 |
| <i>Fanhuai Shi, Xixia Huang, Ye Duan</i>   |     |
| <b>Depth Extraction by Simplified Binocular Vision</b> .....   | 179 |
| <i>Gouhong Ma, J. Qin, F.R. Jiang, H.B. Wang</i>   |     |
| <b>Comparison of Calibration Methods for Image Center</b> .....  | 185 |
| <i>Xizhang Chen, Shanben Chen, Houlu Xue</i>   |     |
| <b>Seam Tracking and Dynamic Process Control for High<br/>Precision Arc Welding</b> .....                        | 193 |
| <i>Huabin Chen, Tao Lin, Shanben Chen</i>  |     |
| <b>Feature Selection of Arc Acoustic Signals Used for<br/>Penetration Monitoring</b> .....                       | 203 |
| <i>Zhen Ye, Jifeng Wang, Shanben Chen</i>  |     |
| <b>Rough Set-Based Model for Penetration Control of<br/>GTAW</b> .....   | 211 |
| <i>Wenyi Wang, Shanben Chen, Wenhang Li</i>  |     |
| <b>A Study of Arc Length in Pulsed GTAW of Aluminum<br/>Alloy by Means of Arc Plasma Spectrum Analysis</b> ..... | 219 |
| <i>Huanwei Yu, Shanben Chen</i>  |     |
| <b>Arc Sound Recognizing Penetration State Using LPCC<br/>Features</b> .....                                     | 229 |
| <i>Jifeng Wang, Yantian Zuo, Yichang Huang, Bo Yang, Song Pan</i>  |     |
| <b>Investigation on Acoustic Signals for On-Line Monitoring<br/>of Welding</b> .....                             | 235 |
| <i>Na Lv, Shanben Chen</i>   |     |
| <b>A Study on Applications of Multi-sensor Information<br/>Fusion in Pulsed-GTAW</b> .....                       | 245 |
| <i>Bo Chen, Shanben Chen</i>   |     |
| <b>Research on Image Process and Tracing of a Welding<br/>Robot</b> .....  | 253 |
| <i>G.H. Ma, L. Wang, G.Q. Liu, M. Xiao</i>   |     |

### Part III: Modeling and Intelligent Control of Welding Processing

|   |            |
|---|------------|
| <b>Predictive Control of Weld Penetration in Pulsed Gas Metal Arc Welding .....</b>   | <b>263</b> |
| <i>Zhijiang Wang, YuMing Zhang, Lin Wu</i>  |            |
| <b>Study on the MLD Modeling Method of Pulsed GTAW Process for Varied Welding Speed .....</b>                               | <b>271</b> |
| <i>Hongbo Ma, Shanben Chen</i>  |            |
| <b>Simulation of Decoupling Control of Pulsed MIG Welding for Aluminum Alloy .....</b>                                      | <b>279</b> |
| <i>Ding Fan, Jiankang Huang, Lihui Lu, Yu Shi</i>   |            |
| <b>Modeling and Decoupling Control Analysis for Consumable DE-GMAW .....</b>  | <b>285</b> |
| <i>Jiankang Huang, Yu Shi, Lihui Lu, Ming Zhu, Yuming Zhang, Ding Fan</i>   |            |
| <b>The Structure Design and Kinematics Simulation for Rotating Arc Sensor of TIG Welding Based on Pro/E 3D Design .....</b> | <b>293</b> |
| <i>Jianping Jia, Hongli Li, Wei Jin, Shunping Yao</i>   |            |
| <b>Knowledge Model Building about a Motor Speed Regulation Fuzzy Control System .....</b>                                   | <b>299</b> |
| <i>Huimin Zhao, Mingyan Ding, Wu Deng, Xiumei Li, Wen Li</i>  |            |
| <b>Research on Surface Recover of Aluminum Alloy PGTAW Pool Based on SFS .....</b>  | <b>307</b> |
| <i>Laiping Li, Xueqin Yang, Fengyan Zhang, Tao Lin</i>  |            |
| <b>Research on Fuzzy-Prediction-Control of GTAW Process Based on MLD Modeling .....</b>                                     | <b>315</b> |
| <i>Mingyan Ding, Hongbo Ma, Shanben Chen</i>  |            |
| <b>Application of Fuzzy Edge Detection in Weld Seam Tracking System .....</b>   | <b>323</b> |
| <i>Zhenyu Xiong, Wen Wan, Jiluan Pan</i>  |            |

### Part IV: Welding Technics and Automations

|  |            |
|--|------------|
| <b>Application and Research of Arc Welding Automation in Korea .....</b> | <b>333</b> |
| <i>Suck-Joo Na</i>   |            |

|  |     |
|--|-----|
| <b>Offline Programming for a Complex Welding System Using DELMIA Automation</b> .....                      | 341 |
| <i>Joseph Polden, Zengxi Pan, Nathan Larkin, Stephen Van Duin, John Norrish</i>                            |     |
| <b>Robot Path Planning in Multi-pass Weaving Welding for Thick Plates</b> .....                            | 351 |
| <i>Huajun Zhang, Hanzhong Lu, Chunbo Cai, Shanben Chen</i>   |     |
| <b>Influence of the Bar Shape on the Welding Quality of Friction Hydro Pillar Processing</b> .....         | 361 |
| <i>Xiangdong Jiao, Hui Gao, Hongwei Zhan, Canfeng Zhou, Jiaqing Chen, Yanqing Zhang</i>                    |     |
| <b>Interference Analysis of Infrared Temperature Measurement in Hybrid Welding</b> .....                   | 369 |
| <i>Jifeng Wang, Houde Yu, Yaozhou Qian, Rongzun Yang</i>   |     |
| <b>Preliminary Investigation on Embedding FBG Fibre within AA6061 Matrices by Ultrasonic Welding</b> ..... | 375 |
| <i>Zhengqiang Zhu, Yifu Zhang, Chun Zeng, Zhilin Xiong</i>   |     |
| <b>Thermal Process Analysis in Welding Prototyping of Metal Structures</b> .....                           | 383 |
| <i>Jian-ning Xu, Hua Zhang, Ronghua Hu, Yulong Li</i>  |     |
| <b>Study on Sub-sea Pipelines Hyperbaric Welding Repair under High Air Pressures</b> .....                 | 391 |
| <i>Canfeng Zhou, Xiangdong Jiao, Long Xue, Jiaqing Chen, Xiaoming Fang</i>                                 |     |
| <br><b>Part V: Special Robot Technology and Systems</b>  |     |
| <b>The Mechanism Design of a Wheeled Climbing Welding Robot with Passing Obstacles Capability</b> .....    | 401 |
| <i>Minghui Wu, Xiaofei Gao, Z. Fu, Yanzheng Zhao, Shanben Chen</i>   |     |
| <b>Anytime Ant System for Manipulator Path Planning</b> .....  | 411 |
| <i>D. Wang, N.M. Kwok, G. Fang, Q.P. Ha</i>  |     |
| <b>Path Planning and Computer Simulation of a Mobile Welding Robot</b> .....                               | 421 |
| <i>Tao Zhang, Shanben Chen</i>   |     |
| <b>The Control System Design of a Climbing Welding Robot Based on CAN Bus</b> .....                        | 429 |
| <i>Xiaofei Gao, Minghui Wu, Z. Fu, Yanzheng Zhao, Shanben Chen</i>   |     |

|  |            |
|--|------------|
| <b>An Implementation of Seamless Human-Robot Interaction<br/>for Pipeline Welding Telerobotics .....</b>   | <b>435</b> |
| <i>Na Dong, Haichao Li, Hongming Gao, Lin Wu</i>   |            |
| <b>Design and Experiment of a Novel Portable All-Position<br/>Welding Robot .....</b>  | <b>443</b> |
| <i>Bin Du, Jing Zhao, Yu Liu</i>   |            |
| <b>The Power and Propulsion of Medical Microrobots .....</b>   | <b>451</b> |
| <i>Xueqin Lv, Rongfu Qiu, Gang Liu, Yixiong Wu</i>   |            |
| <b>Mechanical Design and Analysis of an Articulated-Tracked<br/>Robot for Pipe Inspection .....</b>  | <b>461</b> |
| <i>Z.Y. Chen, G.Z. Yan, Z.W. Wang, K.D. Wang</i>   |            |
| <br><b>Part VI: Intelligent Control and Its Applications<br/>in Engineering</b>  |            |
| <b>A Construction Method of Rational Approximation Model<br/>for Fractional Calculus Operators in Frequency Domain .....</b>                         | <b>471</b> |
| <i>Wen Li, Guanghai Zheng, Bing Nie, Huimin Zhao, Ming Huang</i>   |            |
| <b>Research of Direct Discretization Method of Fractional<br/>Order Differentiator/Integrator Based on Rational<br/>Function Approximation .....</b> | <b>479</b> |
| <i>Bing Nie, Wen Li, Haibo Ma, Deguang Wang, Xu Liang</i>  |            |
| <b>Blind Source Separation of Vibration Signal of Electric<br/>Motor Velocity Modulation System .....</b>  | <b>487</b> |
| <i>Xiumei Li, Wen Li, Yannan Sun, Guanghai Zheng</i>   |            |
| <b>A Survey on Artificial Intelligence Algorithm for<br/>Distribution Network Reconfiguration .....</b>  | <b>497</b> |
| <i>Rongfu Qiu, Xueqin Lv, Shuguo Chen</i>  |            |
| <b>Author Index .....</b>  | <b>505</b> |