

# 2016 4<sup>th</sup> International Conference on Applied Robotics for the Power Industry

## Technical Program

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STATE GRID SHANDONG ELECTRIC POWER COMPANY

## Technical Program

<b>Monday, October 10, 2016</b>		
09:00-18:00	Registration	7F Lobby Hall
18:00-20:00	Dinner	6F Cafeteria
<b>Tuesday, October 11, 2016</b>		
09:00-09:40	Opening Session	6F Crowne Grand
09:40-10:40	Keynote Speech 1 (Rong Li)	6F Crowne Grand
10:40-11:00	Coffee Break	
11:00-12:00	Keynote Speech 2 (Terry Krieg)	6F Crowne Grand
12:00-14:00	Lunch	6F Cafeteria
14:00-15:00	Technical Session Tues.A(Substation Robot 1)	6F Crowne Grand
15:00-15:10	Short Break	
15:10-16:10	Technical Session Tues.B(Substation Robot 2)	6F Crowne Grand
16:10-16:30	Coffee Break	
16:30-18:00	Technical Session Tues.C(Substation Robot 3)	6F Crowne Grand
18:00-20:00	Banquet	
<b>Wednesday, October 12, 2016</b>		
08:30-09:30	Keynote Speech 3 (Joon-Young Park)	7F Gui Wen Room
09:30-09:40	Short Break	
09:40-10:40	Technical Session Wed.A (Unmanned Aerial Vehicles	7F Gui Wen Room
10:40-11:00	Coffee Break	
11:00-12:00	Technical Session Wed.B(Unmanned Aerial Vehicles 2)	7F Gui Wen Room
12:00-14:00	Lunch	6F Cafeteria
14:00-15:00	Technical Session Wed.C (Transmission Line Robot 1)	7F Gui Wen Room
15:00-15:10	Short Break	
15:10-16:10	Technical Session Wed.D (Transmission Line Robot 2)	7F Gui Wen Room

16:10-16:30	Coffee Break	
16:30-18:00	Technical Session Wed. E (Transmission Line Robot 3)	7F Gui Wen Room
18:00-20:00	Dinner	6F Cafeteria
<b>Thursday, October 13, 2016</b>		
08:30-09:30	Keynote Speech 4 (Yunwei (Ryan) Li)	7F Gui Wen Room
09:30-09:40	Short Break	
09:40-10:40	Technical Session Thur.A (Other Applications 1)	7F Gui Wen Room
10:40-11:00	Coffee Break	
11:00-12:00	Technical Session Thur.B(Other Applications 2)	7F Gui Wen Room
12:00-13:30	Lunch	6F Cafeteria
13:30-18:30	Technical Visit	

## Content List of Technical Session

Tuesday Morning, October 11, 2016

Opening Session	
09:00-09:40	6F Crowne Grand Ballroom
Keynote Speech 1 (Rong Li)	
09:40-10:40	6F Crowne Grand Ballroom
Title: <i>Electric Power Robotics Research and Application</i>	
Keynote Speech 2 (Terry Krieg)	
11:00-12:00	6F Crowne Grand Ballroom
Title: <i>Robots and Substations in the Power System of the Future</i>	

Tuesday Afternoon, October 11, 2016

Tues. A	Substation Robot 1	
14:00-14:15	6F Crowne Grand Ballroom	Tues.A.1
0001_FI: <i>Substation Live Working Robot System</i>		
Ronghui Huang, Xin Zhang, Weizhao Huang (Shenzhen Power Supply Co., Ltd., Shenzhen)		
Zhenli Wang (Shan Dong Luneng Intelligence Tech. Co., Ltd., Jinan)		
14:15-14:30	6F Crowne Grand Ballroom	Tues.A.2
0002_FI: <i>Research and Application of the Water Washing Robot with Hot-line Working Used in 220kV open type Substation</i>		
Jian Li, Jianjun Su, Mengchao Fu (State Grid Shandong Electric Power Res. Inst., Jinan)		
Shouyin Lu, Xu Dong (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
14:30-14:45	6F Crowne Grand Ballroom	Tues.A.3
0003_FI: <i>The Remote Control Terminal for Electric Maintenance Robot in Substation</i>		
Yubing Han, Shiyong Mu, Shouyin Lu (State Grid Shandong Electric Power Res. Inst., Jinan)		
Zhenli Wang, Jian Li, Jianxiang Li, Jinlong Zhao (Shandong Luneng		

Intelligence Tech. Co., Ltd., Jinan)		
14:45-15:00	6F Crowne Grand Ballroom	Tues.A.4
0004_FI: <i>The Research and Design of Automatic Sweeping Device of Substation Post Insulator</i>		
Xin Zhang, Guoxing Wu, Peng Wang (Shenzhen Power Supply Co., Ltd., Shenzhen)		
Qiang Chen (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
Tues. B	Substation Robot 2	
15:10-15:25	6F Crowne Grand Ballroom	Tues.B.1
0005_FI: <i>Finite Element Analysis and Vibration Control of the Substation Charged Maintenance Robot</i>		
Xin Zhang, Ronghui Huang, Senjing Yao (Shenzhen Power Supply Co., Ltd., Shenzhen)		
Xu Dong (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
15:25-15:40	6F Crowne Grand Ballroom	Tues.B.2
0006_FI: <i>Design of a 2D Laser Mapping System for Substation Inspection Robot</i>		
Peng Xiao (State Grid Shandong Electric Power Res. Inst., Jinan)		
Taiping Wang, Chao Zhang (State Grid Anhui Electric Power Co. Maintenance Company, Hefei)		
Mengchao Fu, Haipeng Wang (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
Yongxi Li (State Grid 1000kV UHV Huainan Substation, Huainan)		
15:40-15:55	6F Crowne Grand Ballroom	Tues.B.3
0007_FI: <i>A Visual 3D Modelling System for the Robot Autonomous Obstacle Negotiation in Substation</i>		
Chaoying Li, Li Li (State Grid Shandong Electric Power Res. Inst., Jinan)		
Hang Gao (State Grid Liaoning Electric Power Company Maintenance Company, Jinzhou)		
Guanbin Wu, Naiyuan Xu (State Grid Shandong Electric Power Company, Jinan)		
Guowen Tang (State Grid Xiamen Electric Power Supply Company, Xiamen)		

15:55-16:10	6F Crowne Grand Ballroom	Tues.B.4
0008_FI: <i>Ultrasonic Detection Device Design Based on Substation Intelligent Inspection Robot</i>		
Haipeng Wang (State Grid Shandong Electric Power Res. Inst., Jinan)		
Zhigang Ren, Jianxiang Li, Juntao Lv (State Grid Shandong Electric Power Company, Jinan)		
Guowen Tang (State Grid Fujian Electric Power Company, Xiamen)		
<b>Tues. C</b>	<b>Substation Robot 3</b>	
16:30-16:45	6F Crowne Grand Ballroom	Tues.C.1
0009_FI: <i>An Adapted Visual Servo Algorithm for Substation Equipment Inspection Robot</i>		
Hua Fang, Xiaoxiao Cui (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
Liangkun Cui, Yuanxin Chen (State Grid Jiangsu Electric Power Company, Maintenance Company, Nanjing)		
16:45-17:00	6F Crowne Grand Ballroom	Tues.C.2
0010_FI: <i>A New Method of Digital Number Recognition for Substation Inspection Robot</i>		
Xiaoxiao Cui, Hua Fang, Guoqing Yang, Hao Zhou, Yan Deng (Shandong Luneng Intelligence Tech. Co., Ltd., State Grid Corp, Jinan)		
17:00-17:15	6F Crowne Grand Ballroom	Tues.C.3
0011_FI: <i>An Innovative Localization System of Transformer Substation Automation Robots based on Pattern Recognition and ICP algorithm</i>		
Xiaolu Tian, Fang Hua, Tao Wang (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
17:15-17:30	6F Crowne Grand Ballroom	Tues.C.4
0012_FI: <i>Simulation Test System for Substation Patrol Robot</i>		
Kai Sun, Chongguang Fu, Tonghui Jia, Jiake Liu (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
17:30-17:45	6F Crowne Grand Ballroom	Tues.C.5
0013_FI: <i>Kinematics Analysis and Simulation of the Substation Equipment Water Washing Robot with</i>		

<i>Hot-line</i>		
Xu Dong (State Grid Shandong Electric Power Res. Inst., Jinan)		
Huaidong Lu, Yanliang Wang, Huichao Pan (State Grid Shandong Electric Power Company, Jinan)		
Shouyin Lu (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
17:45-18:00	6F Crowne Grand Ballroom	Tues.C.6
0014_FI: <i>Finite Element Analysis and Vibration Control of the Substation Equipment Water Washing Robot with Hot-line</i>		
Xu Dong, Jianjun Su (State Grid Shandong Electric Power Res. Inst., Jinan)		
Yanliang Wang, Xiaohong Chen (State Grid Ji'ning Power Supply Company, Jining)		
Shouyin Lu (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		

Wednesday Morning, October 12, 2016

<b>Keynote Speech 3 (Joon-Young Park)</b>		
08:30-09:30	7F Gui Wen Room	
Title: <i>Experience in Developing Live-line Maintenance Robots</i>		
<b>Wed. A</b>	<b>Unmanned Aerial Vehicles 1</b>	
09:40-09:55	7F Gui Wen Room	Wed.A.1
0015_FI: <i>Design for a Fast High Precision UAV Power Emergency Relief System</i>		
Yi Zhang (State Grid Shandong Electric Power Res. Inst., Jinan)		
Zhigang Ren (State Grid Shandong Electric Power Company, Jinan)		
Liang Liu, Chuanhu Wei, Chaoyuan Yin (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
09:55-10:10	7F Gui Wen Room	Wed.A.2
0016_FI: <i>Platform Design and Test Analysis for UAV Flight Inspection and Testing</i>		
Fei Zhang <sup>1,2</sup> , Mengchao Fu <sup>1,2</sup> , Liang Liu <sup>1,2</sup> , Chuanhu Wei <sup>1,2</sup> , Chaoyuan Yin <sup>1,2</sup>		
(1.State Grid Shandong Electric Power Res. Inst., Jinan)		
(2.Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
10:10-10:25	7F Gui Wen Room	Wed.A.3
0017_FI: <i>Development of Test-Benches for GNSS-</i>		

**Components in Strong Electric and Magnetic Fields**

Henrik Brockhaus, Albert Claudi (Dept. of Power Engineering and High Voltage Tech., Univ. of Kassel, Kassel, Germany)

10:25-10:40 7F Gui Wen Room Wed.A.4

**0018\_FI: An Automatic Diagnostic Method of Abnormal Heat Defect in Transmission Lines based on Infrared Video**

Jing Zhang, Hemeng Yang, Zhengning Zhang, Ke Zhao, Yanfang Chen (Tianjin Zhongwei Aerospace Data System Tech. Co., Ltd., Tianjin)

Xinqiao Wu (Electric Power Res. Inst., China Southren Power Grid, Guangzhou)

**Wed. B**
**Unmanned Aerial Vehicles 2**

11:00-11:15 7F Gui Wen Room Wed.B.1

**0019\_FI: The Method of Insulator Recognition Based on Deep Learning**

Yue Liu (State Grid Shandong Electric Power Res. Inst., Jinan)  
 Jun Yong (State Grid Shandong Electric Power Company, Jinan)  
 Liang Liu, Jinlong Zhao, Zongyu Li (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)

11:15-11:30 7F Gui Wen Room Wed.B.2

**0020\_FI: Transmission Line Intelligent Inspection Central Control and Mass Data Processing System and Application Based on UAV**

Zongyu Li, Shiyou Mu, Jianxiang Li (State Grid Shandong Electric Power Res. Inst., Jinan)  
 Wanguo Wang, Yue Liu (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)

11:30-11:45 7F Gui Wen Room Wed.B.3

**0021\_FI: Automatic Diagnosis System of Transmission Line Abnormalities and Defects based on UAV**

Fangzheng Zhang (State Grid Shandong Electric Power Company, Jinan)  
 Yabo Zhao (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)  
 Wanguo Wang (State Grid Shandong Electric Power Res. Inst., Jinan)  
 Peng Li, Qiaoyun Lin, Lingao Jiang (State Grid Fujian Electric Power Company, Xiamen)

11:45-12:00 7F Gui Wen Room Wed.B.4

**0022\_FI: Out-of-core GPU Accelerated Surface Reconstruction for Large Industrial Environment Monitoring**

Fran çois Mirall ès (Hydro-Qu èbec Res. Inst. (IREQ), Varennes, QC, Canada)  
 Chen Xu (Denis Laurendeau, Department of Electrical Engineering, Laval Univ., Qu èbec, QC, Canada)

**Wednesday Afternoon, October 12, 2016**
**Wed. C**
**Transmission Line Robot 1**

14:00-14:15 7F Gui Wen Room Wed.C.1

**0023\_FI: A State-of-the-Art Survey of the Robotics Applied for the Power Industry in China**

Li Li (State Grid Shandong Electric Power Res. Inst., Jinan), Dong Li, Yong Li (State Grid Shandong Electric Power Company, Jinan)  
 Bin Zhang, Jinlong Zhao (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)  
 Chao Zhang (State Grid Anhui Electric Power Company Maintenance Company, Hefei)  
 Zheren Dai (State Grid Zhejiang Electric Power Company Maintenance Company, Hangzhou)

14:15-14:30 7F Gui Wen Room Wed.C.2

**0024\_FI: New Concept of a Robot for Transmission Lines Inspection**

Alisson Ribeiro (FURNAS, Passos (MG), Brazil)  
 Ricardo Abdo (FURNAS, Rio de Janeiro (RJ), Brazil)  
 Jo ão Oliveira (FURNAS Ivaipor ã (PR), Brazil)

14:30-14:45 7F Gui Wen Room Wed.C.3

**0025\_FI: Geometric Design of an Inspection Robot for 110kV Power Transmission Lines**

Xiang Yue<sup>1,2</sup>, Hongguang Wang<sup>1</sup>, Yingchun Yang<sup>3</sup>, Yong Jiang<sup>1</sup>  
 (1. Shenyang Institution of Automation, CAS, Shenyang)  
 (2. Univ. of CAS, Beijing)  
 (3. Electric Power Res. Inst. Co., Ltd.of Yunnan Power Grid, Kunming)

14:45-15:00 7F Gui Wen Room Wed.C.4

**0026\_FI: Optimization Design of the Multi-unit Serial Inspection Robot for Power Transmission Line**

Guanghong Tao, Lijin Fang, Xinlin Xu(Northeastern Univ., Shenyang)		
<b>Wed. D</b>	<b>Transmission Line Robot 2</b>	
15:10-15:25	7F Gui Wen Room	Wed.D.1
0027_FI: <i>A New Bionic Structure of Inspection Robot for High Voltage Transmission Line</i>		
Jidai Wang, Xiaochen Liu, Kunpeng Lu, Yi Liu, Jing Zhen (Shandong Univ. of Science and Tech., Qingdao)		
15:25-15:40	7F Gui Wen Room	Wed.D.2
0028_FI: <i>A Survey on Insulator Inspection Robots for Power Transmission Lines</i>		
Lin Wang, Hongguang Wang (Shenyang Institute of Automation, CAS, Shenyang)		
15:40-15:55	7F Gui Wen Room	Wed.D.3
0029_FI: <i>A New Climbing Robot for Suspension Insulator Strings</i>		
Lijin Fang, Xinlin Xu, Xiaokun Guo (Northeastern Univ., Shenyang)		
15:55-16:10	7F Gui Wen Room	Wed.D.4
0030_FI: <i>Development of Insulator Cleaning Robot</i>		
Zhiyong Cheng, Juan Jia, Liang Zhong, Rui Guo (State Grid Shandong Electric Power Res. Inst., Jinan)		
Chunlei Han, Richeng Zhu (State Grid Zhejiang Electric Power Company, Hangzhou)		
<b>Wed. E</b>	<b>Transmission Line Robot 3</b>	
16:30-16:45	7F Gui Wen Room	Wed.E.1
0031_FI: <i>Research on a Novel Maintenance Robot for Power Transmission Lines</i>		
Shiyu Xiao, Hongguang Wang, Lie Ling (Shenyang Institute of Automation, CAS, Shenyang)		
16:45-17:00	7F Gui Wen Room	Wed.E.2
0032_FI: <i>Automatic Solar Charging System for Overhead Transmission Line Robot</i>		
Liang Zhong, Rui Guo, Zhiyong Cheng, Juan Jia (State Grid Shandong Electric Power Res. Inst., Jinan)		
Jun Yong (State Grid Shandong Electric Power Company, Jinan)		

17:00-17:15	7F Gui Wen Room	Wed.E.3
0033_FI: <i>Design and Simulation of Mechanical Arm with High Voltage Operation Insulation</i>		
Hui Qi (State Grid Shandong Electric Power Res. Inst., Jinan)		
Xinbin Zuo (State Grid Shandong Electric Power Company, Jinan)		
Hailei Wang, Jianxiang Li (Shandong Luneng Intelligence Tech. Co., LTD., Jinan)		
Mengchao Fu (Shandong Luneng Intelligence Tech. Co., LTD., Jinan)		
17:15-17:30	7F Gui Wen Room	Wed.E.4
0034_FI: <i>Design of High Voltage Insulated Manipulator Control System</i>		
Hailei Wang (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
Xinbin Zuo (State Grid Shandong Electric Power Company, Jinan)		
Hui Qi (State Grid Shandong Electric Power Res. Inst., Jinan)		
Shiyu Mu, Jianxiang Li (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		
17:30-17:45	7F Gui Wen Room	Wed.E.5
0035_FI: <i>A Processing Method for LiDAR Data of Power Line Patrol</i>		
Xinqiao Wu, Xiao Chen, Junbo Huang (Electric Power Res. Inst., China Southern Power Grid, Guangzhou)		
Zhengliang Yan, Ping Wang, Xiaojie Wu (Tianjin ZhongWei Aerospace Data System Tech. Co. Ltd., Tianjin)		
17:45-18:00	7F Gui Wen Room	Wed.E.6
0036_FI: <i>The Research on Early-warning Methods of Tree Barriers of Transmission Lines based on LiDAR Data</i>		
Wei Zhang <sup>1</sup> , Juan Zhang <sup>2</sup> , Bing Wang <sup>2</sup> , Hemeng Yang <sup>2</sup> , ChongWang <sup>2</sup> , Bai Yang <sup>3</sup>		
(1.Electric Power Res. Inst., China Southern Power Grid, Guangzhou)		
(2.Tianjin Zhongwei Aerospace Data System Tech. Co., Ltd., Tianjin)		
(3.Chuxion Helicopter Operating Branch Company of Yunnan Zhongneng Investment Co., Ltd., Kunming)		

Thursday Morning, October 13, 2016

<b>Keynote Speech 4 (Yunwei (Ryan) Li)</b>	
08:30-09:30	7F Gui Wen Room

Title: *Smart Power Converters for Distribution System Power Quality Improvement*

Thur. A	Other Applications 1	
09:40-09:55	7F Gui Wen Room	Thur.A.1
0037_FI: <i>The MASKI + Underwater Inspection Robot: A New Generation Ahead</i> Luc Provencher, Serge Sarraillon (IREQ, Hydro-Québec, Varennes, Canada)		

09:55-10:10	7F Gui Wen Room	Thur.A.2
0038_FI: <i>Design of the Small-sized Hydraulic Wrench</i> Shangwei Yang (State Grid Shandong Electric Power Res. Inst., Jinan) Zhigang Ren (State Grid Shandong Electric Power Company, Jinan) Haipeng Wang, Mengchao Fu, Yongxin Hao (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		

10:10-10:25	7F Gui Wen Room	Thur.A.3
0039_FI: <i>Design and Analysis of a Non-destructive Detecting Mobile Platform for Gas Insulated Switchgear</i> Mingwei Hu, Hongguang Wang, Yong Chang, Xin'an Pan (The Shenyang Institute of Automation, CAS, Shenyang)		

10:25-10:40	7F Gui Wen Room	Thur.A.4
0040_FI: <i>Multifunctional Electric Detection Charged Manipulator</i> Yongxin Hao (State Grid Shandong Electric Power Res. Inst., Jinan) Haipeng Wang, Jinlong Zhao (Shandong Luneng Intelligence Tech.Co., Ltd., Jinan) Xingzhao Wang, Juntao Lv (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		

Thur. B	Other Applications 2	
11:00-11:15	7F Gui Wen Room	Thur.B.1
0041_FI: <i>Mecanum Wheeled Motion System with Three Wheels</i> Yongxin Hao, Xu Dong (State Grid Shandong Electric Power Res. Inst., Jinan) Jianxiang Li, Shiyong Mu (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan) Xingzhao Wang (State Grid Shandong Electric Power Company,		

Jinan)		
11:15-11:30	7F Gui Wen Room	Thur.B.2
0042_FI: <i>Observer-Based Sensorless Control of Permanent Magnet Synchronous Motor for Electrical Vehicle</i> Tongyi Han, Xiao Yang, Qingbao Fang (State Grid Shandong Electric Power Res. Inst., Jinan) Jianxiang Li, Jinlong Zhao, Dexu Huang, Jina Cao (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan)		

11:30-11:45	7F Gui Wen Room	Thur.B.3
0043_FI: <i>Research of Thermal Management Technology for Battery of Robot Working in Alpine Region</i> Jina Cao, Chaoying Li (State Grid Shandong Electric Power Res. Inst., Jinan) Dexu Huang (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan) Huadong Zhang, Yongbo Liu, Xiao Yang (State Grid Shandong Electric Power Company, Jinan)		

11:45-12:00	7F Gui Wen Room	Thur.B.4
0044_FI: <i>A Vision for Electric Power Robotics Standardization</i> Rui Guo (State Grid Shandong Electric Power Res. Inst., Jinan) Chaoying Li (Shandong Luneng Intelligence Tech. Co., Ltd., Jinan) Hongmei Li, Yong Li, Guanbin Wu, Jinlong Zhao (State Grid Shandong Electric Power Company, Jinan)		

Thursday Afternoon, October 13, 2016

Technical Visit	
13:30-18:30	(1) Visit Electric Power Robotics Research & Production Base of SEPCo (2) Visit State Grid 1000kV QuanCheng Substation