WUWNet’18

The 13th ACM International Conference on Underwater Networks & Systems

December 3–5, 2018
Shenzhen, China
https://wuwnet.acm.org/2018/
**Foreword**

Welcome to WUWNet’18, the Thirteenth ACM International Conference on Underwater Networks & Systems!

WUWNet is a premier venue for sharing state-of-the-art research and recent development in underwater sensing, communication, networking and system technology. The conference brings together leading scientists and entrepreneurs from all over the world, shares emerging ideas relevant to underwater technology, connects expertise from multiple disciplines, and contributes to the exploration of the vast oceans on Earth.

After traveling to Canada in 2017, WUWNet visits Shenzhen this year. As one of the most fast-growing cities in China, Shenzhen is known for its vibrant economy. The city is a leading global technology hub, dubbed as the Silicon Valley of China. Recently, Shenzhen has also been recognized as a global leading maritime city. Therefore, this year’s WUWNet will present a very unique experience and opportunity to foster a close bond between state-of-art underwater research and maritime economy.

Since 2006, WUWNet has traditionally offered a strong showing of the research in underwater communications and networking. This year, the Technical Program Committee (TPC) chairs, in consultation with the general chairs and steering committee, sought to broaden WUWNet in order to encourage the involvement of researchers in underwater sensing, robotics, and applications. The TPC is happy to introduce a selected set of diverse and strong papers for presentation, including 11 full papers (8 pages), 19 short papers (5 pages), and 21 extended abstracts (2 pages). Each of the full papers, short papers, and extended abstracts will be given 20 minutes, 13 minutes, and 5 minutes, respectively, for oral presentation, followed by a two-minute discussion.

WUWNet’18 will span three days. The technical program is divided into 8 orally presented technical sessions, covering a plethora of topics including underwater acoustics, wireless communications, networking protocols, networking architecture, underwater sensing, data and image processing, vehicles, systems, simulations, and field experiments. This year, we are also delighted to announce two Pioneer Awards to honor Profs. Ian Akyildiz and TC Yang for their significant contributions to their fields. In addition, following the WUWNet tradition of inviting prestigious researchers to give keynote and plenary speeches in order to review the status of the field, to promote key contributions, and to discuss visions for future directions, we are grateful that Profs. Richard Zhao, Lee Freitag, Zhiqiang Wei, and Fumin Zhang will deliver the talks this year. Further, in view of recent research trends on land and under the water, a panel discussion will be organized on the cutting-edge “Smart Technology: From Land to Ocean”.

WUWNet’18 would have not been possible without the help of many people. We would like to thank the TPC members and reviewers for their thorough and timely efforts. Thanks are also due to our Publication Chairs Lina Pu and Ronak Etemadpour, Financial Chair Chengbing He, Poster Chair Shefeng Yan, Demo Chair Fengzhong Qu, Publicity Chair Yu Luo, Local Arrangement Chairs Xuesi Chen and Huihuan Qian, Keynote/Panel Chairs Haibin Wang and Xiaohui Wei, and Registration Chairs Zhenze Liu and Yishan Su. Also, we would like to express our gratitude to Shenzhen University for
hosting the conference. In addition, we gratefully acknowledge ACM SIGMOBILE for their support.

Our gratitude also extends to the many conference volunteers for their efforts and dedication. Finally, we would like to thank WUWNet’18 sponsors for providing significant financial support to the conference.

We hope that you will find the program interesting and thought-provoking, and that the conference acts as a venue for sharing ideas and exploring topics of mutual interests with other similarly inspired researchers and practitioners from around the world.

Last, but not least, we thank all conference participants for making WUWNet’18 a success, and we wish you an enjoyable and productive conference.

Jingdong Chen and Jun Liu
WUWNet’18 General Co-Chairs

Zheng Peng and Dario Pompili
WUWNet’18 Technical Program Committee Co-Chairs
WUWNet 2018 Organizing Committee

General Co-Chairs

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- Jun Liu (Jilin University)

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- Huihuan Qian (The Chinese University of Hong Kong, Shenzhen)

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- Xiaoyan Hong (University of Alabama)
- Saleh Ibrahim (Taif University)
- Navinda Kottege (CSIRO)
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- Tommaso Melodia (Northeastern University)
- Andrea Munafò (National Oceanography Centre)
- Miao Pan (University of Houston)
- Soo-Hyun Park (Kookmin University)
- Chiara Petrioli (University of Rome "La Sapienza")
- Christian Renner (Hamburg University of Technology)
- Aijun Song (University of Alabama)
- Luiz Vieira (Universidade Federal de Minas Gerais)
- Yiyin Wang (Shanghai Jiao Tong University)
- Zhaohui Wang (Michigan Technological University)
- Wen Xu (Zhejiang University)
- Fumin Zhang (Georgia Institute of Technology)
- Xi Zhang (Texas A&M University)

**Additional Reviewers**

- Yougan Chen (Xiamen University)
- Emrecan Demirors (Northeastern University)
- Fei Dou (University of Connecticut)
- Zafar Iqbal (Michigan Technological University)
- Yi Lou (Harbin Engineering University)
- Fengzhong Qu (Zhejiang University)
- Jiacheng Shi (Northeastern University)
- Wensheng Sun (Michigan Technological University)
- Xingwang Wang (Jilin University)
- zigeng Wang (University of Connecticut)
- Li Wei (Michigan Technological University)
- Xia Xiao (University of Connecticut)
- Saleh Ibrahim (Taif University)
- Navinda Kottege (CSIRO)
- Hovannes Kulhandjian (California State University, Fresno)
- Xiaoli Ma (Georgia Institute of Technology)
- Jianyu Zhang (Jilin University)
In-Cooperation

Association for Computing Machinery (ACM)

Association for Computing Machinery's Special Interest Group on Mobility of Systems, Users, Data and Computing (SIGMOBILE)

Sponsors

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Shenzhen University
CSSC Systems Engineering Research Institute

Institute of Acoustics, Chinese Academy of Sciences

Wuhan Maritime Communication Research Institute
About WUWNet

The oceans cover 71% of the Earth’s surface and represent one of the least explored frontiers; yet, the oceans are integral to climate regulation, nutrient production, oil retrieval, and transportation. Also, water systems in general are of vital importance to life on Earth and commerce. For these reasons, there is significant interest in monitoring aquatic environments for scientific, environmental, commercial, safety, and military purposes.

WUWNet is the premier venue for research and development bringing real-time, in-situ sensing and actuation to this aquatic world. The goal of this conference is to bring together researchers and practitioners in areas relevant to underwater networks and systems. Thus, many aspects of the networking protocol stack - from the physical layer to the application layer and the various system issues - will be represented at this conference. The objective is to serve as a forum for presenting state-of-the-art research and development, for exchanging ideas and experiences, and for facilitating interactions and collaborations.

The conference will span three days, including presentations of keynote speeches, plenary talks, technical papers, and posters/demos. The scope of the WUWNet conference covers a broad range of research directions relevant to underwater networks and network-related signal processing, communications, systems, and applications. Specific topics of interest include, but are not limited to:

- Underwater network and system architectures
- Efficient underwater communications (including acoustic, optical, RF, and wired, etc.), with techniques from the physical layer to the application layer
- Underwater acoustic modeling and signal processing
- Cooperative underwater communications, including, PHY, MAC, routing, and data transfer, etc.
- Networked underwater robotics and systems, such as localization, navigation, security, communication & coordination, or human operator interaction.
- Coordinated energy harvesting systems and power systems for underwater networks and systems
- Energy-efficient algorithms, and protocol design for underwater networks, as well as signal/image processing and communication systems
- Operating system and middleware support for underwater networks and systems
- Applications that broadly address underwater networks and systems, including coordinated underwater vehicles
- Modeling, simulation, and testbeds for underwater systems and platforms
- Experimental results from underwater networking, signal/image processing and communications field trials
- Application requirements for underwater networks, signal/image processing and communication systems presented by end users
# Technical Program Day 1

## WUWNet’18 Program

### Sunday, December 2, 2018 (Day 0)

- **17:00 – 19:00**
  - Registration

### Monday, December 3, 2018 (Day 1)

#### 07:45 – 08:30
- Opening Remarks
  - General Co-Chairs (Jingdong Chen / Jun Liu) & TPC Co-Chairs (Zheng Peng / Dario Pompili)
  - Speech from Sponsors:
  - Shenzhen University (President Qingquan Li); Institute of Acoustics, CAS (Professor Haibin Wang); CSSC Systems Engineering Research Institute (Director Hongjun Zhang)

#### 08:30 – 08:50
- Pioneer Award I
  - T.C. Yang (Zhejiang University)
  - Title: A Collision Free Underwater Acoustic Network: Concept, Signal processing and Experimental Support

#### 08:50 – 09:40
- Keynote Speech
  - Richard Zhao (Southern University of Science and Technology)
  - Title: Potential Applications of New Underwater Communication Technologies in Offshore Engineering

#### 09:40 – 10:25
- Coffee Break

#### 10:25 – 10:35
- Plenary Speech I
  - Lee Freitag (Woods Hole Oceanographic Institution)
  - Title: Undersea Acoustic Communications to Advance Scientific Research: A Thirty Year Journey

#### 10:35 – 11:10

#### 11:10 – 12:30
**Technical Session I: Underwater Communications I**

- Session Chair: Haibin Wang
- 2 full paper [44 min], 2 short paper [30 min]. Total: 74 min

- **A Practical Guide to Chirp Spread Spectrum for Acoustic Underwater Communication in Shallow Waters**, Fabian Steinmetz, Jan Heitmann and Christian Renner (Hamburg University of Technology, Germany), **Full Paper**

- **Doppler Effect Mitigation over Mobile Underwater Acoustic OFDM System**, Jingxin Xu and Deqing Wang (Xiamen University, P.R. China); Xiaoyi Hu (Communication Engineering Department of Xiamen University, P.R. China); Yongjun Xie (Xiamen University, P.R. China), **Full Paper**

- **Doppler Correction of Mobile Acoustic Communication via Adjustable AD Sampling Rate**, Xiaoyang Wang and Siyuan Zheng (Xiamen University, P.R. China); Qiuyang Tao and Fumin Zhang (Georgia Institute of Technology, USA); Aijun Song (University of Alabama, USA); F Tong (Xiamen University, P.R. China), **Short Paper**

- **Precoded OFDM over Underwater Acoustic Channels**, Jun Tao; Liang An; Jun Tao, Liang An, Shuai Yao and Lin Zhou (Southeast University, P.R. China); Xiao Han (Harbin Engineering University, P.R. China); Zhen Qin (Southeast University, P.R. China), **Short Paper**

#### 12:30 – 13:30
- Lunch (Poster & Demo Setup)

#### 13:30 – 14:55
**Technical Session II: Underwater Acoustics I**

- Session Chair: Daniel Rouseff
- 2 full paper [44 min], 1 short paper [15 min], 3 extended abstracts [21 min]. Total: 80 min

- **Underwater Acoustic Intensity Field Reconstruction by Kriged Compressive Sensing**, Jie Sun, Jiancheng Yu and Zhang Aiqun (Shenyang Institute of Automation, Chinese Academy of Sciences, P.R. China); Aijun Song (University of Alabama, USA); Fumin Zhang (Georgia Institute of Technology, USA), **Full Paper**
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<tr>
<td>14:55 – 15:05</td>
<td>Coffee Break</td>
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<tr>
<td>15:05 – 16:45</td>
<td><strong>Technical Session III: Underwater Networks I</strong></td>
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<td>Session Chair: Zheng Peng</td>
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<td>2 full paper [44 min], 2 short paper [30 min], 3 extended abstracts [21 min]. Total: 95 min</td>
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<td><strong>Robust TDA-MAC for Practical Underwater Sensor Network Deployment: Lessons from USMART</strong>, Nils Morozs, Paul D Mitchell and Yury Zakharov (University of York, United Kingdom (Great Britain)); Rahul Mourya (Heriot-Watt University, United Kingdom (Great Britain)); Yves Petillot (HWU, United Kingdom (Great Britain)); Tyler Gibney and Mauro Dragone (Heriot-Watt University, United Kingdom (Great Britain)); Benjamin Sherlock, Jeffrey A. Neasham and Charalampos C. Tsimenidis (Newcastle University, United Kingdom (Great Britain)); Mohammed E. Sayed, Alistair McConnell, Simona Aracri and Adam Stokes (The University of Edinburgh, United Kingdom (Great Britain)), <strong>Full Paper</strong></td>
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<td><strong>Protocol Emulation Platform Based on Microservice Architecture for Underwater Acoustic Networks</strong>, Hua Yu, Fei Ji, Fang-Jiong Chen, ZhongHeng Chen and Quansheng Guan (South China University of Technology, P.R. China), <strong>Full Paper</strong></td>
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<td><strong>Time-Based Adaptive Collision-Avoidance Real-Time MAC Protocol for Underwater Acoustic Sensor Networks</strong>, Xiaoxiao Zhuo, Fengzhong Qu, Hong Yang and Yezhou Wu (Zhejiang University, P.R. China) <strong>Short Paper</strong></td>
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<td><strong>Study on Interference Effect against MAC Layer Protocol in Underwater Acoustic Network</strong>, Junqing Zhang, Gangqiang Zhang and Junkai Liu (Science and Technology on Underwater Acoustic Antagonizing Laboratory, P.R. China) <strong>Short Paper</strong></td>
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<td><strong>A Learning-Based ALOHA Protocol for Underwater Acoustic Sensor Networks</strong>, Linlin Wang (Beijing Institute of Space Long March Vehicle, P.R. China); Can Lin (Xiamen University, P.R. China); Keyu Chen (Xiamen University; Key Laboratory of Underwater Acoustic Communication and Marine Information Technology, P.R. China); Yuyu Zhang (Beijing Institute of Space Long March Vehicle, P.R. China), <strong>Extended Abstracts</strong></td>
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<td><strong>A MAC Protocol Design for Underwater Acoustic WiFi Network</strong>, Xiaohe Pan, Junhong Cui and Jun Liu (Jilin University, P.R. China), <strong>Extended Abstracts</strong></td>
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<td><strong>A Power-Controlled Depth-Based Routing Protocol for Underwater Wireless Sensor Networks</strong>, Hua Yu, Junjie Wang, Quansheng Guan, Fei Ji and Fangjiong Chen (South China University of Technology, P.R. China), <strong>Extended Abstracts</strong></td>
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<td>16:45 – 17:00</td>
<td>Speech from Shiming Liu, Director of Shenzhen Nanshan Science &amp; Technology Innovation Bureau</td>
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<td>17:00 – 18:00</td>
<td>Poster &amp; Demo Session</td>
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<td>18:00 – 19:00</td>
<td>Welcome Reception</td>
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<td>19:00 – 19:30</td>
<td>Transport to Talent Park</td>
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<td>19:30 – 21:30</td>
<td>Light Show (Shenzhen Talent Park)</td>
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<td>08:00 – 08:30</td>
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| 08:30 – 09:20 | Pioneer Award II
Ian Akyildiz (Georgia Institute of Technology)
Title: Underwater Communication Challenges in the Next Decade |
| 09:20 – 09:55 | Plenary Speech II
Zhiqiang Wei, Ocean University of China; Xiaohui Wei, Jilin University
Title: Building a Cloud-Coordinated Marine Intelligent Internet of Things and Big Data System |
| 09:55 – 10:05 | Coffee Break                                                         |
| 10:05 – 12:10 | **Technical Session IV: Underwater Applications**
Session Chair: Fumin Zhang
2 full paper [44 min], 2 short paper [30 min], 2 invited talks [40 min], 1 extended abstracts [7 min].
Total 121 min |
|             | - Implementation of AUV and Ship Noise for Link Quality Evaluation in the DESERT Underwater Framework, Emanuele Coccolo, Filippo Campagnaro, Alberto Signori, Federico Favaro and Michele Zorzi (University of Padova, Italy), Full Paper |
|             | - New Non-reference Image Quality Evaluation Method for Underwater Turbulence Blurred Images, Zanghe Miao (Xiamen University, P.R. China), Full Paper |
|             | - Riding the Stress Wave: Integrated Monitoring, Communications, and Networking for Subsea Infrastructure, Miao Pan (University of Houston, USA), Invited Talk |
|             | - Efficient Pipeline Architectures for Underwater Big Data Analytics, Ayman Alharbi (Umm al-Qura University, Kingdom of Saudi Arabia), Invited Talk |
|             | - ROV Assisted Magnetic Induction Communication Field Tests in Underwater Environments, Debing Wei, Steban Soto, Javier Garcia and Aaron Becker (University of Houston, USA); Li Wang (Beijing University of Posts and Telecommunications, P.R. China); Miao Pan (University of Houston, USA), Short Paper |
|             | - Optical Imaging Study of Underwater Acousto-optical Fusion Imaging System, Jun Liu, Wenxue Guan, Jiaxin Liu and Xiaoyu Wang (Jilin University, P.R. China), Short Paper |
|             | - Underwater Image Processing: MSRCR Algorithm Based on the Guided Filtering of Sobel Operator, Lu Teng and Feng Xue (Northwestern Polytechnical University, P.R. China), Extended Abstracts |
| 12:10 – 13:10 | Lunch                                                                |
| 13:10 – 14:50 | **Technical Session V: Underwater Communications II**
Session Chair: Lee Freitag
2 full paper [44 min], 3 short paper [45 min], 1 extended abstracts [7 min]. Total 96 min |
<p>|             | - A LFM-based Adaptive Wake-up Signal Detection Approach for Underwater Acoustic Communication System, Haiyu Li, Deqing Wang and Yongjun Xie (Xiamen University, P.R. China); Xiaoyi Hu (Communication Engineering Department of Xiamen University, P.R. China), Full Paper |
|             | - A novel CM-DSSS modulation scheme for robust communication over the underwater acoustic channel, Shengjun Xiong, Zhenduo Wang and Chao Wang (Hangzhou Applied Acoustic Research Institute, P.R. China), Full Paper |
|             | - A Study on Link Adaptation Using OFDM System in the Shallow Water of Yellow Sea of Korea, Kilyong Kim, Kye-Won Kim, Tae-Ho Im, Yong-Ho Cho, Min-Sang Kim and Hak-Lim Ko (Hoseo University, Korea), Short Paper |
|             | - Resource Allocation in Underwater Acoustic OFDMA Downlink Systems, Zhaobang Chen, Meiqin Liu, Senlin Zhang and Ronghao Zheng (Zhejiang University, P.R. China), Short Paper |
|             | - The Research of MIMO-FBMC in Underwater Acoustic Communication, Yueyue Wang (University of Chinese Academy of Sciences, P.R. China); Yupeng Tai and Haibin Wang (State Key Laboratory of Acoustics, Chinese Academy of Sciences, P.R. China); Jun Wang (State Key Laboratory of Acoustics, Institute of Acoustics, P.R. China); Weiming Gan (Institute of Acoustics, Chinese Academy of Sciences, P.R. China), Short Paper |</p>
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<tr>
<td>14:50 – 15:00</td>
<td>Coffee Break</td>
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<td>15:00 – 16:25</td>
<td><strong>Technical Session VI : Underwater Networks II</strong></td>
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<td>Session Chair : Miao Pan</td>
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<td>3 short paper [45 min], 5 extended abstracts [35 min]. Total 80 min</td>
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<td><em>Multi-Beam Uncoordinated Random Access MAC for Underwater Communication Networks</em>, Bryan Ehlers, Ananya Sen Gupta and Ryan McCarthy (University of Iowa, USA), <a href="#">Short Paper</a></td>
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<td><em>Multi-hop Underwater Acoustic Networks based on BATS Codes</em>, Shenghao Yang, Jun Ma and Xuan Huang (The Chinese University of Hong Kong, Shenzhen, P.R. China), <a href="#">Short Paper</a></td>
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<td><em>A NS-3 Compatible Emulation Framework for Underwater Acoustic Network</em>, XiaoHui Zeng (South China University of Technology, P.R. China); Zhaohui Luo, Fang-Jiong Chen, Hua Yu, Fei Ji and Quansheng Guan (South China University of Technology, P.R. China), <a href="#">Short Paper</a></td>
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<td><em>Underwater - Network Management System on the Internet of Underwater Things</em>, Khamdamboy Urunov (Kookmin University, Korea); Soo-Young Shin (University of Kookmin, Korea); Soo-Hyun Park (Kookmin University, Korea), <a href="#">Extended Abstracts</a></td>
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<td><em>Connectivity of Underwater Cognitive Acoustic Networks Under Spectrum Constraint</em>, Qiu Wang and Hong-Ning Dai (Macau University of Science and Technology, Macao); Hao Wang (Norwegian University of Science and Technology, Norway); Qubeijian Wang (Macau University of Science and Technology, Macao), <a href="#">Extended Abstracts</a></td>
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<td><em>SO-Link: A Light-weight Underwater Wireless Acoustic Sensor Networking Protocol Stack Architecture for Education</em>, Jifeng Zhu, Junhong Cui and Jun Liu (Jilin University, P.R. China), <a href="#">Extended Abstracts</a></td>
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<td><em>Self-Organizing Synergetic Denial-of-Service in Underwater Named Data Networking</em>, Yue Li, Yingjian Liu, Haoyu Yin and Hao Teng (Ocean University of China, P.R. China), <a href="#">Extended Abstracts</a></td>
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<td><em>Research on Underwater Information Covert Transmission Technology</em>, Junkai Liu (Science and Technology on Underwater Acoustic Antagonizing Laboratory, P.R. China); Yangze Dong (Shanghai Ship Research &quot;, USA); Wei Zhang (Science and Technology on Underwater Acoustic Antagonizing Laboratory, P.R. China), <a href="#">Extended Abstracts</a></td>
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<td>16:25 – 16:35</td>
<td>Coffee Break</td>
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<td>16:35 – 17:35</td>
<td><strong>Panel</strong></td>
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<td>Smart Technology: From Land to Ocean!</td>
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<td>Moderators: Jun-Hong Cui (Jinlin University); Fumin Zhang (Georgia Institute of Technology)</td>
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<td>Panelists: Lee Freitag (WHOI); Daniel Rouseff (University of Washington); Dario Maggiorini (University of Milano); Miao Pan (University of Houston); Shefeng Yan (Institute of Acoustic, Chinese Academy of Science); Fengzhong Qu (Zhejiang University); Tong Xie (Decent Capital)</td>
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<td>17:35 – 18:35</td>
<td>Poster &amp; Demo Session</td>
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<td>18:35 – 19:05</td>
<td>Transport to Banquet</td>
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<td>19:05 – 21:05</td>
<td>Conference Banquet (Award Presentations and Sponsors’ Remarks)</td>
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| 08:00 – 08:30| Plenary Speech III  
Fumin Zhang, Georgia Institute of Technology  
Title: Mobile Data Collection in an Aquatic Environment: Cyber Maritime Cycles for Distributed Autonomy |
| 08:30 – 09:05| Technical Session VII: Underwater Communication III  
Session Chair: Fengzhong Qu  
5 short papers [75 min], 2 abstracts [14 min], Total 89 min |
| 09:05 – 10:40| - Differential Cyclic Shift Keying Spread Spectrum Underwater Acoustic Communication; Pengyu Du (Science and Technology on Sonar Laboratory, Hangzhou Applied Acoustic Research Institute, P.R. China); Yinghao Lee (Science and Technology on Sonar Laboratory, Hangzhou Applied Acoustic Research Institute, P.R. China); Chao Wang (Hangzhou Applied Acoustic Research Institute, P.R. China), Short Paper  
- Adaptive Modulation Switching Strategy Based on Q-learning for Underwater Acoustic Communication Channel; Jiamin Lin, Xialin Jiang, Wei Su and Liang Xiao (Xiamen University, P.R. China), Short Paper  
- Multicollinearity Problem of CPM Communication Signals and Its Suppression Method with PLS Algorithm, Chao Li (State Key Laboratory of Acoustics, Institute of Acoustics, Chinese Academy of Sciences, P.R. China); Haibin Wang (State Key Laboratory of Acoustics, Chinese Academy of Sciences, P.R. China); Jun Wang (State Key Laboratory of Acoustics, Institute of Acoustics, P.R. China); Yupeng Tai (State Key Laboratory of Acoustics, Chinese Academy of Sciences, P.R. China); Fan Yang (LE2I EA7508, Université Bourgogne Franche-Comté, France), Short Paper  
- Relay-Assisted Optical Wireless Communications in Turbid Water, Kapila W S Palitharathna (Sri Lanka Technological Campus, Sri Lanka); Ke Xiaoquan, Fei Yuan, Gao Chunxian and En Cheng (Xiamen University, P.R. China), Short Paper  
- A Robust and Efficient Digital FM Underwater Acoustic Voice Communication System based on SNR Estimation, Ke Xiaoquan, Fei Yuan, Gao Chunxian and En Cheng (Xiamen University, P.R. China), Short Paper  
- Fuzzy Modulation Recognition of Non-cooperation Underwater Acoustic Communication Signals; Junkai Liu (Science and Technology on Underwater Acoustic Antagonizing Laboratory, P.R. China); Weihua Jiang, F Tong and Dongsheng Chen (Xiamen University, P.R. China); Gangqiang Zhang (Science and Technology on Underwater Acoustic Antagonizing Laboratory, P.R. China); Yangze Dong (Shanghai Ship Research & quot;, USA), Extended Abstracts  
- OSDM Based Adaptive Multi-mode Underwater Acoustic Communication System, Lanjun Liu, Hao Zhao, Jiong Niu and Lin Zhou (Ocean University of China, P.R. China); Jiucai Jin (The First Institute of Oceanography, SOA, P.R. China); Jie Zhang (State Oceanic Administration, P.R. China); Zhichao Lv (Harbin Engineering University, P.R. China); Junfeng Wang (Tianjin University of Technology, P.R. China); Xiaohui Zeng, Extended Abstracts |
| 10:40 – 10:50| Coffee Break |
| 10:50 – 12:15| Technical Session VIII: Underwater Sensing, Localization and Data Processing  
Session Chair: Shefeng Yan  
1 full paper[22 min], 1 short papers [15 min], 6 abstracts [42 min], Total 79 min |
<p>|             | - KNN Regression Model-Based Refinement of Thermohaline Data: Lessons from USMART Sea Trials, Yu Gou, Jun Liu and Tong Zhang (Jilin University, P.R. China), Full Paper |</p>
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<tr>
<td>12:15 – 12:25</td>
<td>Closing Remarks and Adjourn: Presenting Best Demo and Poster Awards</td>
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A Collision Free Underwater Acoustic Network: Concept, Signal processing and Experimental Support

T.C. Yang

Professor
Zhejiang University
ASA FELLOW

ABSTRACT:

Underwater acoustic communications are limited by the bandwidth due to characteristics of sound attenuation via scattering loss and sea water absorption. As a result, acoustic communications under the water between a network of users have to share the same bandwidth. Without spectrum sharing, when signals transmitted by different sources arrived at the receiver at the same time, whether intended or not intended for the said user, they interfere with each other. Communications are often lost as a result, since the signals are not orthogonal to each other, and there is no a priori way to separate them. This phenomenon is referred to as signal collision. Signal collision can be avoided by controlling the signal access to the channel, referred to as media access control (MAC). MAC is difficult in underwater water acoustic channels when signal travel time is long, time-varying, and cannot be predicted precisely. Signal collision occurs when there exists a source unknown to the receiving node (with unknown position), such as an incoming autonomous underwater vehicle, which can transmit a signal causing signal collision. To prevent signal collision, one can either allow sufficient time separations between transmissions, or require handshaking before transmission using protocols such as request-to-send (RTS), clear-to-send (CTS) etc. In either case, the communication channel is left idle for a large portion of the time, consequently the usage rate of the channel, or the network (data) throughput rate, is low. The alternative is to broadcast the signal repeatedly, so that the intended message can be reconstructed from the collision free portion of the data. It is not an efficient use of the channel; since continuously transmitting the signal not only consumes lots of energy but also acoustically pollute the channel causing harm to marine animals. Many MAC algorithms have been proposed in the literature. The actual network throughput rate achieved so far experimentally has been found (much) smaller than that predicted by the theory due to unknown random channel effect and higher data loss not accounted for by the theory. It seems difficult to avoid signal collisions in practice using MAC protocols. An alternative method to avoid collision is proposed here based on superdirectivity and supergain derived from superdirective beamforming using a small size circular array. The concept, approach and experimental results that support this approach will be reviewed.

BIO:

T. C. Yang received the Ph.D. degree in high energy physics from the University of Rochester, Rochester, NY, USA, in 1971. He is currently a Professor and previously a Pao Yu-Kong Chair Professor at the Zhejiang University. From 2012 to 2014, he was a National Science Counsel Chair Professor at the Nat. Sun Yat-Sen Univ. Kaohsiung, Taiwan. Before that, he spent 32 years working at the Naval Research Laboratory, Washington, DC, serving as Head of the Arctic Section, Dispersive Wave Guide Effects Group, and acting Head of the Acoustic Signal Processing Branch, and consultant to the division on research proposals.

His current research focuses on: (1) environmental impacts on underwater acoustic communications and networking, exploiting the channel physics to characterize and improve performance, (2) environmental acoustic sensing and signal processing using distributed networked sensors, and (3) methods for improved channel tracking and data-based source localization. In earlier years, he pioneered matched mode processing for a vertical line array, and matched-beam processing for a horizontal line array. Other areas of research included geoaoustic inversions, waveguide invariants, effects of internal waves on sound propagation in shallow water, Arctic acoustics, etc. He is a fellow of the Acoustical Society of America.
Underwater Communication Challenges in the Next Decade

Ian F. Akyildiz

Professor
The School of Electrical and Computer Engineering,
Georgia Institute of Technology
Director of the Broadband Wireless Networking Laboratory
Chair of the Telecommunications Group
IEEE FELLOW & ACM FELLOW

ABSTRACT:
Underwater communication systems have drawn the attention of the research community in the last 15 years. This growing interest can largely be attributed to new civil and military applications enabled by large-scale networks of underwater devices (e.g., underwater static sensors, unmanned autonomous vehicles (AUVs), and autonomous robots), which can retrieve information from the aquatic and marine environment, perform in-network processing on the extracted data, and transmit the collected information to remote locations. Although many solutions have been introduced the last 1.5 decades many grand challenges such as low data rates, long latency, still exist. In this talk there will be a look into the next decade and further challenges and possible solutions will be presented.

BIO:
I.F. Akyildiz is the Ken Byers Chair Professor with the School of Electrical and Computer Engineering, Georgia Institute of Technology, Director of the Broadband Wireless Networking Laboratory and Chair of the Telecommunications Group. Dr. Akyildiz is also Megagrant winner in Russia. He is Megagrant lead researcher at the Institute for Information Transmission Problems, Kharkevich Institute, Russian Academy of Sciences in Moscow, Russia since January 2018.

He is the Editor-in-Chief of Computer Networks (Elsevier) Journal since 2000 and the founding Editor-in-Chief of the Ad Hoc Networks Journal (2003) both published by Elsevier. Dr. Akyildiz is an IEEE FELLOW (1996) and an ACM FELLOW (1997). He received numerous awards from IEEE and ACM. Due to Google scholar, his papers received over 105+K citations and his h-index is 115 as of October 2018. His current research interests are in Underwater Communication, Internet of xThings, 5G Wireless Systems, Software Defined Networking, Nano-Scale Communications.
Potential Applications of New Underwater Communication Technologies in Offshore Engineering

Richard Zhao

Professor
Southern University of Science and Technology
Chief Flow Assurance Engineer/Expert (CNOOC)

ABSTRACT:
In the production of offshore oil and gas, the statuses of all subsea facilities need to be closely monitored and controlled. During the production process, huge amount of data or signals could be generated, and need to be transported back and forth between/among the control room and the subsea facilities timely. Nowadays, the offshore industry uses various types of umbilical widely for the communication channels. To improve the production rate, increase the recovery ratio, and reduce the cost, it is unavoidable to design and install more production facilities subsea. As the subsea system becomes more complicated, it will be a challenge to keep utilizing the traditional umbilical system for the data or signal communications. This presentation will discuss the possible demands for underwater communications; explore the possibilities and difficulties applying the emerging underwater communication technologies.

BIO:

Dr. Zhao is a Research Professor of Southern University of Science and Technology. He received his MS degree in Dynamics and Control from the Department of Engineering Mechanics of Tsinghua University, and the Ph.D. from the Ocean Engineering program, Texas A&M University. He spent his early 5 years in aerospace engineering, and his later 25 years in the offshore engineering. His experiences include the design of telecommunication system and control system of spacecraft, and the design of subsea production system of offshore oil and gas. He was once a senior Principal Engineer, Project and Solutions Development Supervisor, an Expert (Technip USA), and a Chief Flow Assurance Engineer/Expert (CNOOC).
Undersea Acoustic Communications to Advance Scientific Research: A Thirty Year Journey

Lee Freitag

Principal Engineer
Department of Ocean Physics and Engineering, Woods Hole Oceanographic Institution

ABSTRACT:
Over the past thirty years there have been many major advancements in undersea acoustic communications technology. These advancements have been made for a number of reasons, including basic improvements in electronics and computing, an enhanced understanding of the acoustic propagation environment and a rapid increase in the sophistication of adaptive signal processing for wireless communications. The results have been striking, and acoustic modems are now ubiquitous on scientific research vehicles and remote sensors.

The results of improved wireless undersea communications technology have enabled new generations of autonomous underwater vehicles (AUVs) that now explore the ocean and map the seafloor on our behalf. Deep and shallow-water scientific research now depends on acoustic communications for monitoring and control of AUVs, and missions are managed remotely, increasing the effectiveness and thus the cost efficiency of research vehicles. The multitude of applications and the diversity of needs has resulted in the development of configurable and programmable modems that can be tailored to specific vehicles and adapted to new missions. As a result, scientific research that depends on using AUVs under wireless control is accepted and commonplace, leading to innovative applications that would not otherwise been feasible or deemed too risky.

However, despite the rising number of fielded research systems and many successful missions there is much work still to be done to improve undersea acoustic communications technology. The questions which this talk will address include: What are the scientific major applications for wireless acoustic communications? What have the major successes been? How has technology advanced in the past thirty years? What were the key innovations along the way? And what do these things tell us about the future?

BIO:
Lee Freitag holds BS and MS degrees in Electrical Engineering from the University of Alaska, Fairbanks. He has spent his professional career in the Applied Ocean Physics and Engineering Department at the Woods Hole Oceanographic Institution (WHOI) where he has worked for the past 30 years. Throughout this period, he has worked on primarily on underwater acoustic communication and navigation to support ocean science, unmanned underwater vehicles and Navy systems. One of his first tasks at WHOI was to work with Josko Catipovic to develop an m-ary FSK modem that ultimately evolved into what is now the Teledyne class of acoustic modems. Subsequently he worked on acoustic tomography systems for several years, which provided exposure to long-range ocean acoustic propagation and oceanography. In the late 1990s he worked on the development of long-range acoustic communications for Navy systems, and the methods developed for that project are still in use today. That work was followed by development of the Micro-Modem, which initially provided command and control of small vehicles performing shallow-water operations. The Micro-Modem was transitioned to Hydroid with the REMUS 100 vehicle, and it continues to be incorporated into the REMUS product lines, with hundreds of units sold to date.

He manages a team of engineers in the Applied Ocean Physics and Engineering Department at WHOI who focus nearly exclusively on acoustic communications and related system integration and field testing. Recent innovations of the team include development of an under-ice acoustic navigation and communication system that is designed to aid autonomous vehicles sample and monitor the Arctic Ocean at ranges of hundreds of kilometers. He has participated in more than 50 scientific cruises around the world, from the Arctic to the equator.
Building a Cloud-Coordinated Marine Intelligent Internet of Things and Big Data System

Zhiqiang Wei
Professor
Dean of the College of Information Science and Engineering,
Ocean University of China
Director of the Super-Computing Center
Pilot National Laboratory for Marine Science and Technology

Xiaohui Wei
Professor
Dean of the College of Computer Science and Technology,
Jilin University
Director of High Performance Computing Center,
Jilin University

ABSTRACT:
The ocean is the cradle of life and the main road of transportation. Observation, theory and calculation have always been the three cornerstones of our understanding of the ocean. With the rapid development of new generation information technologies such as edge computing, Internet of Things, big data, artificial intelligence, marine scientific and technology research and development have entered a new era. This report will focus on the relevant work of the Pilot National Laboratory for Marine Science and Technology (Qingdao) in the marine Internet of Things, the super-computing internet and the deep blue brain.

Bio of Dr. Zhiqiang Wei:
Zhiqiang Wei is the Dean of the College of Information Science and Engineering, Ocean University of China. He is also the Director of the Super-Computing Center, Pilot National Laboratory for Marine Science and Technology. His research interests include smart computing and intelligent information system. He received BS, MS and PhD from Shandong University, Harbin Institute of Technology and Tsinghua University, respectively. He worked as a post-doc at the Graduate School of Chinese Academy of Science, and served as a technical committee member at Haier Group Corporation and Hisense Co., Ltd. He was selected into the New Century Talent Program by the Minister of Education in 2005. He received the Shandong Province Technology Award for Young Scholars. He directed 25 projects from the Nature Science Foundation (China), National 863 Program, and Department of Science and Technology International Co-operation Program. He published over 200 papers and owned 30 patent. He also received Shandong Province Science and Technology Development First-class Award (ranked number one) and other 6 awards.

Bio of Dr. Xiaohui Wei:
Xiaohui Wei is a professor and the dean in the College of Computer Science and Technology (CCST), Jilin University. He is currently the director of High Performance Computing Center, Jilin University. His current major research interests include resource scheduling for large distributed systems, infrastructure level virtualization, large-scale data processing system and fault-tolerant computing.
Mobile Data Collection in an Aquatic Environment: Cyber Maritime Cycles for Distributed Autonomy

Fumin Zhang
Professor
The school of Electrical and Computer Engineering, Georgia Institute of Technology
NSF CAREER Awardee
http://fumin.ece.gatech.edu/

ABSTRACT:

There is a perceivable trend for robots to serve as networked mobile sensing platforms that are able to collect data in aquatic environments in unprecedented ways. We argue that the effective transformation between Eulerian and Lagrangian data streams represents a fundamental principle underlying many ongoing research efforts. Timely transformation of data streams is the major challenge to construct cyber cycles that are needed by marine autonomy. Data driven machine learning methods have great potential, but are constrained by special difficulties for underwater communication. A distributed autonomy structure that is able to cope with the limited information sharing is envisioned as the future. This challenge can only be addressed by interdisciplinary efforts from researchers in underwater acoustics, underwater networking, and marine robotics, many are active contributors of the WUWNet.

This talk will discuss recent advancements towards integrating marine robotic platforms with underwater communication and networking technology. In particular, we will address the influences from both environmental motions (caused by ocean flow) and controllable platform motion on the transformation of the data streams. Even though such motions have been known to degrade the performance of acoustic communication and networking, the quantitative relationships have yet to be established, calling for tremendous efforts for theoretical analysis, simulations, and experimental study. One of our approaches, named Motion tomography (MT), develop generic environmental models (GEMs) to combine computational ocean models with real-time data streams collected by mobile sensing platforms to provide high-resolution predictions of ocean current in a small spatial area around the mobile platforms. With better known environmental motion, the performance of acoustic networking can be better analyzed. This will be demonstrated through lab-based experiments leveraging micro autonomous vehicles equipped with acoustic modems. Our efforts also indicate that future research requires open and cost-effective experimental infrastructure that integrates marine robotic platforms, underwater acoustic device, and underwater networking equipment.

BIO:

Dr. Fumin ZHANG is Professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. He received the B.S. and M.S. degrees from Tsinghua University, Beijing, China, in 1995 and 1998, respectively. He received a PhD degree in 2004 from the University of Maryland (College Park) in Electrical Engineering, and held a postdoctoral position in Princeton University from 2004 to 2007.

His research interests include mobile sensor networks, maritime robotics, control systems, and theoretical foundations for cyber-physical systems. He received the NSF CAREER Award in September 2009 and the ONR Young Investigator Program Award in April 2010. He is currently serving as the co-chair for the IEEE RAS Technical Committee on Marine Robotics, associate editors for IEEE Journal of Oceanic Engineering, Robotics and Automation Letters, IEEE Transactions on Automatic Control, and IEEE Transactions on Control of Networked Systems. He also serves as the deputy editor-in-chief for the Cyber-Physical Systems Journal.
Smart Technology: From Land to Ocean

Moderators

Jun-Hong Cui  Professor of Jilin University
Fumin Zhang  Professor of Georgia Institute of Technology

Panelists

Lee Freitag  Principal Engineer of WHOI
Dario Maggiorini  Assistant Professor of University of Milano
Miao Pan  Assistant Professor of University of Houston
Fengzhong Qu  Professor of Zhejiang University
Daniel Rouseff  Professor of University of Washington
Tong Xie  Executive Director of Decent Capital
Shefeng Yan  Professor of Institute of Acoustic, Chinese Academy of Science
Jun-Hong Cui

Professor

College of Computer Science and Technology,
Jilin University

Director of smart ocean research center, Jilin university

BIO:

Dr. Cui received her Ph.D. degree in Computer Science from UCLA in 2003. Currently, she is a Full Professor in the College of Computer Science and Technology, Jilin University, China. From Aug. 2003 to Aug. 2017, she was on faculty in the Computer Science and Engineering Department at University of Connecticut (UConn). She also served as the Assistant Dean for Graduate Studies and Diversity of School of Engineering at UConn from 2009-2012. At UConn, Jun-Hong founded and is leading the interdisciplinary UnderWater Sensor Network Lab, which involves more than 30 faculty members from eight departments across two schools. From 2012 to 2014, she led the efforts to launch an NSF I/UCRC (Industry/University Cooperative Research Center) for Smart Ocean Technology, in collaboration with University of Washington. In the research community, Jun-Hong co-founded the first ACM International Workshop on UnderWater Networks (WUWNet’06), which now has become a stand-alone premium conference in the area.

She has been serving as the WUWNet steering committee chair. Jun-Hong received 2007 NSF CAREER Award and 2008 ONR Young Investigator Award. She also received the United Technologies Corporation (UTC) Professorship in Engineering Innovation award at UConn in 2008 and UCLA Engineering Distinguished Young Alumnus Award in 2010. She received Outstanding Junior Faculty Mentoring Award, School of Engineering UConn in 2013 and became an elected CASE (Connecticut Academy of Science and Engineering) member in 2014. Starting from 2016, Dr. Cui joined Jilin University as a Special Expert for the China 1000 Talent Program (selected in 2015) and founded the first Smart Ocean Research Center in China.

Dario Maggiorini

Assistant professor

University of Milano

BIO:

Dario Maggiorini is assistant professor at the University of Milano, Italy; where he received his master degree and PhD in computer science in 1997 and 2002 respectively. He joined as a faculty member the department of Informatics and Communication in 2003, where his teaching activity is typically related to operating systems and network protocols and architectures.

In the past, he has been working on Quality of Service for IP networks, multimedia content delivery, application-level networking, and software architectures for service provisioning.

Currently, his research interests focus mainly on software and network architecture for entertainment applications and content/service provisioning in distributed environments.
Miao Pan

Assistant Professor
Department of Electrical and Computer Engineering,
University of Houston
Member of ACM and a Senior Member of IEEE
NSF CAREER Awardee

BIO:

Miao Pan is now an Assistant Professor in the Department of Electrical and Computer Engineering at University of Houston. He received his Ph.D. degree in Electrical and Computer Engineering from the University of Florida in 2012, MASc degree in electrical and computer engineering from Beijing University of Posts and Telecommunications in 2007 and BSc degree in Electrical Engineering from Dalian University of Technology in 2004, respectively.

He was a recipient of NSF CAREER Award in 2014. Dr. Pan's research interests include cognitive networking, cybersecurity, and cyber-physical systems. He has published more than 50 papers in prestigious journals including IEEE/ACM Transactions on Networking, IEEE Journal on Selected Areas in Communications, IEEE Transactions on Mobile Computing, and Transactions on Dependable and Secure Computing, and over 70 papers in top conferences such as IEEE INFOCOM, ICDCS, and IEEE IPDPS. His work won Best Paper Awards in VTC 2018, Globecom 2017 and Globecom 2015, respectively. Dr. Pan is an Associate Editor for IEEE Internet of Things (IoT) Journal from 2015 to 2018. He is a member of ACM and a senior member of IEEE.

Fengzhong Qu

Professor
The Institute of Marine Information Science and Technology,
Zhejiang University

BIO:

Fengzhong Qu (S'07-M ’10-SM ’15) received his B.S. and M.S. degrees from Zhejiang University, Hangzhou, China, in 2002 and 2005, respectively, both in Electrical Engineering. He received his Ph.D. degree from the Department of Electrical and Computer Engineering at the University of Florida, Gainesville, in 2009. From 2009 to 2010, he was an adjunct research scholar with the Department of Electrical and Computer Engineering at the University of Florida. Since 2011, he has been with the Ocean College at Zhejiang University, Zhoushan, China, where he is presently a professor and chair of the Institute of Ocean Sensing and Networking. He is an associate editor of IEEE transactions on Intelligent Transportation systems, IET Communications and China Communications. His current research interests include underwater acoustic communications and networking, signal processing, and ocean technology.
Daniel Rouseff
Affiliate Scientist of Applied Physics Laboratory
University of Washington
Chief Scientist on the 2009 Cooperative Array Performance Experiment

BIO:

Daniel Rouseff received the Ph.D. degree in electrical engineering from the University of Washington, Seattle, WA USA, in 1989. After graduation, he joined the Senior Professional Staff at the Milton S. Eisenhower Research Center, Applied Physics Laboratory, Johns Hopkins University, Laurel, MD. In 1992, he returned to the University of Washington, where he is currently an Affiliate Scientist at that university’s Applied Physics Laboratory. Since 2012, he has also been an Adjunct Research Associate Professor at Portland State University, Portland, OR, in the Department of Electrical and Computer Engineering. He has held visiting positions at the Naval Research Laboratory, Washington DC, and the Department of Applied Mathematics and Theoretical Physics, Cambridge University, Cambridge, U.K.

Dr. Rouseff was Chief Scientist on the 2009 Cooperative Array Performance Experiment (CAPEx09), a joint China-USA underwater acoustics experiment. His primary technical interests are underwater communications, acoustical oceanography, and physics-based signal processing. Dr. Rouseff is a Fellow of the Acoustical Society of America and a Senior Member of IEEE.

Shefeng Yan
Professor
Institute of Acoustic, Chinese Academy of Science
Senior Member of IEEE

BIO:

Shefeng Yan received the B.Sc., M.Sc., and Ph.D. degrees in electrical engineering from Northwestern Polytechnical University, Xi’an, China, in 1999, 2001, and 2005, respectively. He was a Postdoctoral Research Associate with the Institute of Acoustics, Chinese Academy of Sciences (IACAS), Beijing, China, from 2005 to 2007, and with the Department of Electronics and Telecommunications, Norwegian University of Science and Technology, Trondheim, Norway, from 2007 to 2009, respectively.

Shefeng Yan is currently a Professor with IACAS, as well as with the University of Chinese Academy of Sciences, Beijing, China. His research interests include acoustics signal processing, statistical and array signal processing, and underwater acoustic communications. Prof. Yan is a senior member of IEEE. He is a recipient of the 2010 ICA-ASA Young Scientist Grant for excellent contributions to Acoustics and a co-recipient of the Best Paper Awards at SENSORCOMM 2008, WASPAA 2009 and WCSP 2018.
Tong Xie

Executive Director of Decent Capital

BIO:

Executive Director @ Decent Capital
Angel Investor, Entrepreneur, ex-IBMer, I/T Architect, Geek, Runner & Skier

Tong is currently working in Decent Capital as Executive Director. He is focusing on AI related hard tech. Tong has over 20 years of I/T industry experience with rich management, entrepreneurship, strategic planning, business development, technical sales, solution architecture and software engineering skills.

Decent Capital was founded by Mr. Jason Zeng, co-founder & ex-COO of Tencent, in 2007. Decent would like to empower innovative brilliance and make a positive impact on society. Decent works closely with entrepreneurs, adopts a long term strategic vision to invest in their companies at early stages and offers coaching & other value-added services to them.

As the head of North America operation and high-tech related investment, Tong is continuously searching “Hard Tech” companies in following areas: Enterprise Services, Cloud Computing, New Interfaces, AI/ML/Big Data, Sensor Networks, Edge Computing, Industry IoTs and Industry UAVs.

Tong has the Master of Business Administration from The Chinese University of Hong Kong & Bachelor of Computer Science from Zhejiang University.

Tong is the Board member/Observer/Investor in the following portfolio companies:
- JOUAV (Industry VTOL UAV)
- Pegasus Aeronautics (Hybrid Powertrain for UAVs)
- Oculii (4D Point Cloud Radar for Autonomous Driving)
- Smart Ocean Technology (Underwater Communication & Mesh Network)
- Firefly (Dynamic Smart City with Targeted Advertising Contents)
- Esperanto Tehnologies (Energy-efficient RISC-V solutions for AI)
- ReachLabs (FarField Wireless Charging for Industry IoT)
- SmartEar (Handfree Enterprise IM/NLP)
- BrainCo (Brain Machine Interface Wearables/BMI-AI)
- Lightelligence (Programmable Nano-photonics Processor for AI)
- Lime (Dock Free Bikes & e-Scooters for Smart City)
- Wigwag (IoT Gateway & PaaS Solution for Smart Buildings)
- Transreport (Passenger Assist & Sensor Network for UK Railways)
- Anteland (High precision printing plate equipment provider)
**Venue**

WUWNet’18 will take place at Science and Technology Building of Shenzhen University, located at: Nanhai Ave 3688, Shenzhen, Guangdong, P.R.China, 518060. Shenzhen University is about 13 miles away from Shenzhen Bao’an International Airport.

**Transportation**

The major international airport in Shenzhen is Bao'an International Airport. From the airport, buses, metro subway and taxis are available to take you to different locations in the city.

**Attractions**

Shenzhen is the first special economic zone of China, serving as a window for China’s Reform and Opening. Now, Shenzhen has developed into an international city with great influence, creating the “Shenzhen Speed”, which attracts worldwide attention. Shenzhen has a lot to offer. Below are some helpful resources for general tourist information:

· [sz.gov.cn](http://sz.gov.cn)
· [trip advisor](http://tripadvisor)

Famous and popular local attractions include but are not limited to:

· Window of the World
· Splendid China Folk Culture Village
· Xiaomeisha Ocean World
· Hongshulin
· Shenzhen OCT Bay
Jilin University

Jilin University, located in Changchun City, Jilin Province, was founded in 1946. It is a key comprehensive university under the direct jurisdiction of the Ministry of Education, and strongly supported by China’s “Project 211” and “Project 985”. In 2000, Jilin University merged with the former Jilin University of Technology, the former Norman Bethune University of Medical Sciences, the Science and Technology and Changchun Institute of Posts and Telecommunications. In 2004, the former University of Military Logistics also joined.

Jilin University offers a wide range of disciplines, including 43 colleges or schools, covering 13 academic categories, namely, philosophy, economics, law, education, literature, history, science, engineering, military science, medical studies, management, and art. There are 129 undergraduate programs, 304 accredited postgraduate programs, 244 accredited doctoral programs and 42 centers for post-doctoral studies, 47 first-class university and discipline construction projects.

Jilin University boasts outstanding faculties. There are 6,633 faculty members in total, among which there are 2,016 professors and 1,213 doctoral advisors. There are 28 members of Chinese Academy of Sciences or Chinese Academy of Engineering (including 18 adjunct members), 7 senior professors of philosophical and social sciences, 20 members of assessment group of the Academic Degrees Committee of the State Council, 34 as the national talents and 7 in “10,000 Talents Project”, 9 national-level outstanding teachers, 5 chief experts in research and construction projects of the Marxism theory in the central government, 5 chief scientists in the national “Program 973”, 13 young and middle-aged experts with prominent contribution, 35 as the academic leading talents, 32 winners of the “National Outstanding Youth Fund”, 16 winners of “National Excellent Youth Fund” and 65 selected in “Changbai Mountain Scholars” in Jilin Province.

Our university is now home to five state key labs, 1 national engineering laboratories, 5 national-local joint laboratories, 1 national engineering and technology research center, 6 humanities and social science key research bases of the Ministry of Education, 11 key laboratories of the Ministry of Education and 24 key laboratories of other ministries. Jilin University has undertaken a great number of research projects at both national and provincial level, generating considerable scientific achievements with good prospects for industrialization and high technical content.
Northwestern Polytechnical University

Northwestern Polytechnical University (NPU), located in the historic city of Xi'an, is the only multidisciplinary and research-oriented in China that is simultaneously developing education and research programs in the fields of aeronautics, astronautics, and marine technology engineering. It is now affiliated to the Ministry of Industry and Information Technology (MIIT).

Since the establishment of the People's Republic of China (PRC), NPU has always been one of the nation’s key universities. NPU ranked among China’s top 15 universities in the state’s 7th and 8th Five-Year plans; and NPU is one of the first 22 universities to have established a graduate school. It was one of the first universities to enter into the 211 Project in 1995 and the 985 Project in 2001. NPU is a member of the "Outstanding University Alliance" program and is honored as a National Role Model Unit, a National Pioneer for Optimal Advanced Basic-level Party Organization and a Model University for Graduate Employment etc.

About SMST:

The School of Marine Science and Technology(SMST), one of the strongest research faculty of NPU, has 11 professional laboratories and one coastal research institute in Qingdao. It centers on the area of marine engineering equipment, underwater vehicle, underwater detection systems, etc. The main involved disciplines include: Mechanics, Mechanical Engineering, Control Science, Naval Architecture and Marine Engineering, Acoustics, Signal and Information Processing, Communication Engineering, Computer Science, Artificial Intelligence, etc. SMST has launched science and technology cooperation as well as talents joint-training programs with prestigious universities and research institutions of America, Canada, England, Australia and Russia. ‘Overseas Expertise Introduction Center for the Study of Ocean Information Sensing (111 Center)’ approved by the Ministry of Education of China, aims to figure out main questions in regard to the information sensing in deep blue. It rests on four divisions: Ocean Signal Processing, Underwater Acoustic Communication, Marine Multiphysics Exploration, and Sensing Platform Power Control. 111 Center Contact: international_smst@nwpu.edu.cn

To grow into a world famous university with first-class disciplines, NPU is strengthening its efforts to recruit excellent scholars from all over the world. Job opportunities please check website http://en.nwpu.edu.cn/EnglishNew/Jobs/Overview.htm
Shenzhen University

Shenzhen University (SZU) is located at the city of Shenzhen, China’s pioneering city of reform and open-up. Titled with “the Special Economic Zone University, the Window University, the Experimental University”, SZU has grown into a multi-discipline university hosting over 30,000 students, 2,500 professional teachers and staff members since its founding three decades ago.

SZU, characterized by its youthful vigor, beautiful campus and rapid growth, offers bachelor, master and PhD degree in great variety of programs. With the state-of-art facilities and a devoted and professional teaching and research team, SZU is committed to an innovative, high-level and international prominent university.

One of our goals is to cultivate students’ innovative and entrepreneurial spirit to lead the progress of the society. In order to achieve this goal, the university has built its capability by expanding libraries and labs, increasing the opportunities for student internships and overseas exchanges.

SZU is committed to internationalization. With over 200 overseas partner universities, SZU attracts about 1,500 international students every year.

Owing to the local pleasant climate, SZU is one of the most beautiful universities in China with rolling hills covered with lichee trees and flowers, two lakes, a wooded hill, an abundance of green space and works of art. We welcome students and friends wherever you are to come and join us. Here, let us work together to create a bright future.
The Chinese Ocean Detection Technology Research Institute co., LTD.

The Chinese ocean detection technology research institute co., LTD. (hereinafter referred to as the "detection") was founded in 2015 by China state shipbuilding corporation, LTD. (hereinafter referred to as the "group") approval in wuxi, the registered capital of 360 million yuan, is a group company and wuxi city people's government under the strategic cooperation framework agreement to undertake ocean detection technology industrial park construction and development of the main body, planning covers an area of 565 mu.

With "ocean perception" as the industrial development direction and new technologies and new products research and development in the fields of ocean observation, target detection and Marine engineering protection as the main business, the exploration institute is a state-owned high-tech enterprise dedicated to serving the national strategy and devoting itself to intelligent Marine engineering construction.

Detecting court set up r&d center, underwater observation, high frequency imaging sonar engineering and Marine equipment protection engineering three divisions/joint venture company, is developing underwater network connection device, the bottom of the sea photoelectric composite online monitoring equipment, Marine environment characteristics of remote sensing to obtain equipment, anti-corrosion materials are more than 20 products.

Focus on the needs of the development of the national Marine engineering, adhere to the "development of detection equipment, military and civilian depth fusion, moderately related multivariate, production, use one" for the purpose, and combined with "civil-military integration, with harmony, innovation mechanism, and coordinated development" ideas, such as detecting the court will become has the domestic first-class research conditions, to create a first-class innovative talents, first-class technology, first-class engineering performance of the leading enterprises, exert important influence in the field of ocean exploration, for military and civilian integration development, the construction of Marine power to make due contributions.
State Key Laboratory of Acoustic, Chinese Academy of Science

State Key Laboratory of Acoustics (SKLA) is the only State Key Laboratory oriented to the acoustic research in China. It is attached to the Institute of the Acoustics of Chinese Academy of Sciences (CAS). In 1987, State Planning Commission approved the establishment of SKLA. SKLA was founded at the end of 1989 and officially opened in Sept. 1990. SKLA was rated as "Excellence" in the total of four national assessments in 1991, 1994, 2000 and 2005, respectively.

In the 10th and 20th anniversary awards ceremony for the construction of State Key Laboratories in 1995 and 2005, SKLA was awarded the title of “Advanced State Key Laboratory”, and Academician ZHANG Renhe was awarded the title of “Advanced Individual of The State Key Laboratory Program”.

SKLA is devoted to the advances and national strategic requirements in the field of acoustics. The goal of SKLA is to build a high-level fundamental research and development base of acoustics. SKLA focuses on the interdisciplinary study between the sound field and acoustic information processing, as well as rapid technology transformations from the academic achievements to the practical applications. SKLA’s responsibilities include providing the consultation services to the state regarding the national ocean development program, talent training, leading the acoustic research and development of China, and establishing a world-famous academic organization.

The research areas of SKLA include underwater acoustics, ultrasonics and aeroacoustics, especially covering the sound field characteristics and acoustic information processing techniques within the liquid, gaseous and solid mediums. Up to the present, SKLA has a staff of 115, including 2 academicians of the Chinese Academy of Sciences, 42 professors, 41 associated professors, 2 State Innovation Research Teams, 2 CAS Innovation Research Teams, 3 Scientific and Technological Innovation Leading Talents of “National High-Level Talent Special Support Program”, 1 Outstanding Young Talent of “National High-Level Talent Special Support Program”, 2 recipients of “National Science Fund for Distinguished Young Scholars”, 1 Outstanding Young Talent of National Defense Science and Technology, 1 Principal Scientist of “973 Program”, 1 Principal Scientist of “National Defense Science and Technology Innovation Special Zone Theme”, 8 recipients of “CAS Hundred-Talent Program”, 1 recipient of “Chinese Young Science and Technology Award”, 1 recipient of “CAS Young Scientists Award”, 2 recipients of “High-Level Innovation and Entrepreneurship Talent Program” of Jiangsu Province, 3 IEEE Senior members, 1 recipient of “Wang Kuancheng Talent Award” of CAS, 2 recipients of “Lu Jiaxi Young Talent Award” of CAS, 1 Excellent Member and 9 members of the Youth Innovation Promotion Association of CAS, a part-time staff of 60 in the domestic and foreign academic organizations, and a part-time staff of 21 in the domestic and foreign academic journals.
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