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June 16-21, Honolulu, Hawaii, USA

The Twenty-ninth (2019) International
**Ocean and Polar
Engineering Conference**
(Offshore and Polar Engineering Conference)

Including *additional ISOPE symposia:*

1st Additive Manufacturing

2nd Environment Assisted Cracking

4th Underwater Technology

8th Tsunami & Safety

9th Asset Integrity

10th Arctic Science & Technology

10th Cryogenic/Arctic Materials

10th Renewable Energy & Environment

11th Sloshing Dynamics & Design

LNG Membrane, Processing, Bunkering

14th Deep Ocean Mining & Gas Hydrates

17th High-Performance Materials

ISOPE-2019

Honolulu, Hawaii, USA, June 16-21

*Updated
Technical Program*

Refereed papers from 50+ countries in 151 technical general
3 Plenary and 6 Keynote and multiple Focus sessions
Full Program with General Information, Advance Registration and Venue
Hotel, Paper List, Reservations, and Updates on
<http://www.isopec.org/index.php/conferences-symposia-and-workshops/>
ISOPE-2019 Conference proceedings

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International Society of Offshore and Polar Engineers (ISOPE)
With cooperating organizations (listed inside)



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ISOPE-2019 Honolulu
The 29th Annual ISOPE-2019 Conference, Honolulu, Hawaii,
June 16-21, 2019

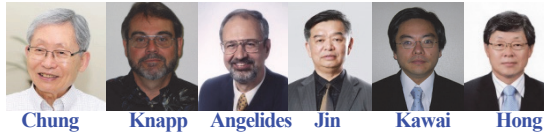


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ISOPE-2019 Conference Co-chairs

**Jin S Chung (USA); Ronald Knapp (USA); Demos Angelides (Greece);
Xiaojian Jin (China); Hiroyasu Kawai (Japan); Seok Won Hong (Korea)**



ISOPE-2019 Honolulu Conference Secretariat: ISOPE, USA



Presentations at ISOPE-2018 Sapporo Banquet
Awards: Scholarships, Best Organizer, Jin S Chung Award,
C H Kim Award, 2019 Best Student Paper

Welcome to the ISOPE-2019 Conference

We greatly appreciate the excellent response, with **1300+** abstracts, and help we have received from colleagues around the world in the successful organization of the 29th International Ocean and Polar (Arctic) Engineering Conference (**ISOPE-2019**), Honolulu, Hawaii, USA, June 16–21, 2019. The Conference features **151** sessions of peer-reviewed papers and 10 plenary and keynote presentations from more than **50+** countries, including the ISOPE specialty symposia as a part of the ISOPE-2019 Conference.

The conference program is issued in 2 versions: Session time and rooms printed and full conference program online (www.isopec.org).

The purposes of the ISOPE conference are to:

- * Promote technological progress and activities, international technological transfer and cooperation, and opportunities for engineers to maintain and improve technical competence; and
- * Provide a timely international forum for technical activities, cooperation, opportunity and fellowship among researchers and engineers by developing focused session topics with high-quality papers (in both originality and significance) accepted through rigorous review, establishing high international standards for publication and worldwide distribution, and promoting interdisciplinary interaction between academia and industry.

The International Society of Ocean and Polar Engineers (ISOPE) has already held 59 successful international meetings with all peer-reviewed papers:

- 1st (1990) European Offshore Mechanics Symposium (**EUROMS-90**) Trondheim; EUROMS-99 Moscow; EUROMS-2012 Istanbul.
- 1st (1990) Pacific/Asia Offshore Mechanics Symposium (**PACOMS-90**) Seoul; Beijing; Pusan; Daejeon; Vladivostok; Dalian; Bangkok; Busan; Vladivostok; Shanghai; Gold Coast, Jeju Island, 2018 .
- Annual **ISOPE** conferences, starting in Edinburgh, 1991, have been held in San Francisco, Singapore, Osaka, The Hague, Los Angeles, Honolulu, Montréal, Brest, Seattle, Stavanger, Kitakyushu, Honolulu, Toulon, Seoul, San Francisco, Lisbon, Vancouver, Osaka, Beijing, Maui, Rhodes, Anchorage, Busan and Hawaii Kona, Rhodes, San Francisco, Sapporo. Since 1992, the annual ISOPE conference program has been the world's largest of its kind with peer-reviewed papers.
- 1st (1995) ISOPE Ocean Mining & Gas Hydrates Symposium (**OMS-95**; **OMGH**), Tsukuba, 1995; Seoul; Goa; Szczecin; Tsukuba; Changsha; Lisbon; Chennai, Szczecin; Kona Hawaii, Sapporo, 2018.
- 1st (1996) International Deep-Ocean Technology (**IDOT-96**) Symposium and Workshop, 1996 Los Angeles; Stavanger, 2001; Beijing 2009.
- ISOPE **HPM** (High-Performance Materials) Symposium: Started in Honolulu 2003 and expanded every year with emerging topics.
- ISOPE Series of specialty symposia: **ANGT**; **SBD**; Nanotechnology **NANOS**; Frontier Energy; Sloshing & Dynamics; Renewable Energy/Environment; Tsunami; Arctic Sci & Tech; Arctic Materials; Asset Integrity; High-Mn/Cryogenic Materials; Materials Reliability, EAC.

On behalf of the Technical Program Committee, it is our pleasure to welcome participants from all over the world to the ISOPE-2020 Conference in Shanghai, China.

Jin S Chung, USA	Ronald H Knapp USA	Demos Angelides Greece
Xiaojian Jin China	Seok-Won Hong Korea	H Kawai Japan

Co-chairs of the ISOPE-2019 Conference

SUNDAY JUNE 16

09:00 ISOPE Board of Directors Meeting Ilima Boardroom, 6F
10:30 ISOPE Executive Committee Meeting Ilima Boardroom, 6F
EUROMS and PACOMS Executive Committees
15:00-18:00
CONFERENCE REGISTRATION Coral Lounge, 6F
17:00-18:00
WELCOME RECEPTION ~~Great Lawn~~ → Coral 4-5, 6F

Tour Information Visit tour desk in Foyer or www.isopec.org

MONDAY JUNE 17

On-Site Registration starts at 07:30 Coral Lounge, 6F
07:30 Session Chair/Co-chair Briefing Coral Lounge, 6F

08:30 Conference Opening Coral 3, 6F
08:30
1 OCEAN AND ARCTIC TECHNOLOGY: Challenges Coral 3
10:30
2. HYDRODYNAMICS I: Wave Mechanics 1 Coral 1
3. DIGITAL, AI, Learning I Coral 2
4. RENEWABLE ENERGY I: Wave Energy 1 Coral 4
5. VORTEX-INDUCED VIBRATIONS I Coral 5
6. HPM I: Adv Materials S Pacific 1
7. ENVIRONMENT I: Oil Spill, Emission S Pacific 2
8. OCEAN TECHNOLOGY I: Installation 1 S Pacific 3
9. ADVANCED SHIP TECH I: EEDI, Added Resistanc S Pacific 4
10. GEOTECH I: Spudcan Sea Pearl 2-4
11. UNDERWATER I: Sensing & Navigation 1 Nautilus Ste

13:10 Plenary, Keynotes
Recent Wave Modelling: P L-F Liu, NUS, Singapore Coral 1
Modeling Hydrogen Embrittlement: P. Sofronis, Illinois, USA Cancelled
Russian Arctic Ice Cover: Review (Keynote): AARI, Russia Nautilus Ste

14:00
12. HYDRODYNAMICS II: Wave Mechanics 2 Coral 1
13. DIGITAL, IT, AI, Learning II Coral 2
14. RENEWABLE ENERGY II: Wave Energy 2 Coral 4
15. VORTEX-INDUCED VIBRATIONS II Coral 5
16. HPM II: Low-Temperature, Cryogenic Materials S Pacific 1
17. ENVIRONMENT II: EcoSystem, Water Quality S Pacific 2
18. OCEAN TECHNOLOGY II: Installation 2 S Pacific 3
19. ADVANCED SHIP TECH II: Resistance S Pacific 4
20. GEOTECH II: Pile Foundation Sea Pearl 2-4
21. UNDERWATER II: Sensing & Navigation 2 Nautilus Ste
16:20
22. HYDRODYNAMICS III: MetOcean 1 Coral 1
23. SLOSHING I: Physics & Prediction Coral 2
24. RENEWABLE ENERGY III: Wave Energy 3 Coral 4
25. VORTEX-INDUCED VIBRATIONS III Coral 5
26. HPM III: Corrosion Monitoring, Mitigation S Pacific 1
27. COASTAL I: Wave Mechanics S Pacific 2
28. OCEAN TECHNOLOGY III: Jackup, Jacket S Pacific 3
29. ADVANCED SHIP TECH III: Navigation 1 S Pacific 4
30. GEOTECH III: Soil Characterization 1 Sea Pearl 2-4
31. UNDERWATER III: Dynamics Nautilus Ste
18:30 ISOPE Technical Committee Meetings: Notice on bulletin board
New members are welcome.

TUESDAY JUNE 18

07:30 Session Chair/Co-chair Briefing	Coral Lounge, 6F
08:00	
32. HYDRODYNAMICS IV: MetOcean 2	Coral 1
33. SLOSHING II: Coupled Sloshing Response 1	Coral 2
34. RENEWABLE ENERGY IV: Wave Energy 4	Coral 4
35. SUBSEA, PIPELINES, RISERS I: Pipeline 1	Coral 5
36. HPM IV: Advances in Welding Technology 1	S Pacific 1
37. COASTAL II Wave Modeling	S Pacific 2
38. OCEAN TECHNOLOGY IV: Floating Dynamics 1	S Pacific 3
39. ADVANCED SHIP TECH IV: Navigation 2	S Pacific 4
40. GEOTECH IV: Soil Characterization 2	Sea Pearl 2-4
41. UNDERWATER IV: Control	Nautilus Ste
10:30	
42. HYDRODYNAMICS V: Storm Surge, Flooding	Coral 1
43. SLOSHING III: Coupled Sloshing Response 2	Coral 2
44. RENEWABLE ENERGY V: Offshore Wind Structure 1	Coral 4
45. SUBSEA, PIPELINES, RISERS II: Pipeline 2	Coral 5
46. HPM V: Advances in Welding Technology 2	S Pacific 1
47. COASTAL III: Tide & Estuary	S Pacific 2
48. OCEAN TECHNOLOGY V: Floating Dynamics 2	S Pacific 3
49. ADVANCED SHIP TECH V: Propulsor	S Pacific 4
50. GEOTECH V: Suction Bucket Foundation	Sea Pearl 2-4
51. UNDERWATER V: Design	Nautilus Ste
13:10	
<i>Prof. Jin S Chung Award and Lecture (D Fairchild)</i>	Coral 1
14:00	
52. HYDRODYNAMICS VI: Loads, Response 1	Coral 1
53. TSUNAMI I: Generation & Observation	Coral 2
54. RENEWABLE ENERGY VI: Offshore Wind Structure 2	Coral 4
55. SUBSEA, PIPELINES, RISERS III: Pipeline 3	Coral 5
56. HPM VI: Fatigue & Fracture 1	S Pacific 1
57. COASTAL IV: Waves on Structures	S Pacific 2
58. OCEAN TECHNOLOGY VI: Floating Dynamics 3	S Pacific 3
59. ADVANCED SHIP TECH VI: Structures	S Pacific 4
60. GEOTECH VI: Offshore Foundation 1	Sea Pearl 2-4
61. UNDERWATER VI: Panel	Nautilus Ste
16:20	
62. HYDRODYNAMICS VII: Loads, Response 2	Coral 1
63. TSUNAMI II: Propagation & Transformation	Coral 2
64. RENEWABLE ENERGY VII: Offshore Wind 3: Floating 1	Coral 4
65. SUBSEA, PIPELINES, RISERS IV: Riser 1	Coral 5
66. HPM VII: Fatigue & Fracture 2	S Pacific 1
67. COASTAL V: Behavior of Structures	S Pacific 2
68. OCEAN TECHNOLOGY VII: Floating Dynamics 4	S Pacific 3
69. ADVANCED SHIP TECH VII: Strength	S Pacific 4
70. GEOTECH VII: Offshore Foundation 2	Sea Pearl 2-4
71. ARCTIC I: Ice Kinematics	Nautilus Ste
15:30 Awards Committee Meeting	Ilima Board room, 6F
16:30 Board of Editors Meeting	Ilima Board room, 6F
19:00 ISOPE-2019 Student Get-together	TBA
19:30 ISOPE-2019/ISOPE-2020 Shanghai TPC Meeting	TBA

Find Digital Conference Program Updates in
<http://www.isopec.org/index.php/conferences-symposia-and-workshops/>

WEDNESDAY JUNE 19

07:30 Session Chair/Co-chair Briefing	Coral Lounge, 6F
08:00	
72. HYDRODYNAMICS VIII: Loads, Response 3	Coral 1
73. TSUNAMI III: Structure & Scouring	Coral 2
74. RENEWABLE ENERGY VIII: Offshore Wind 4: Floating2	Coral 4
75. SUBSEA, PIPELINES, RISERS V: Riser 2	Coral 5
76. HPM VIII: Asset Integrity I: Structure, Asset Integrity 1	S Pacific 1
77. COASTAL VI: Storm Surge & Protection	S Pacific 2
78. OCEAN TECHNOLOGY VIII: LNG, Bunkering 1	S Pacific 3
79. ADVANCED SHIP TECH VIII: Cavitation	S Pacific 4
80. GEOTECH VIII: Simulation & Experiment	Sea Pearl 2-4
81. ARCTIC II: Ice Properties	Nautilus Ste
10:30	
82. HYDRODYNAMICS IX: CFD 1- FSI	Coral 1
83. TSUNAMI IV: Flooding	Coral 2
84. RENEWABLE ENERGY IX: Offshore Wind 5: Floating 3	Coral 4
85. SUBSEA, PIPELINES, RISERS VI: Riser 3	Coral 5
86. HPM IX: Asset Integrity II: Structure, Asset Integrity 2	S Pacific 1
87. COASTAL VII: Sediment Transport	S Pacific 2
88. OCEAN TECHNOLOGY IX: LNG, Bunkering 2	S Pacific 3
89. ADVANCED SHIP TECH IX: Powering, Performance	S Pacific 4
90. GEOTECH IX: Site Characterization	Sea Pearl 2-4
91. ARCTIC III: Russian Arctic	Nautilus Ste
12:00 ISOPE Board of Directors Meeting III	Ilima Board room, 6F
13:10 Keynotes	
Digital Twin for Marine Risers: M Triantafyllou MIT,USA	Coral 5
Management of Ice Risks: Canada: I Kubat, NRC Canada	Nautilus, 6F
14:00	
92. HYDRODYNAMICS X: CFD 2 Hydrodynamics 1	Coral 1
93. HYDRODYNAMICS XVI: Impact, Hydroelasticity	Coral 2
94. RENEWABLE ENERGY X: Offshore Wind 6: Floating 4	Coral 4
95. SUBSEA, PIPELINES, RISERS VII: Umbilicals 1	Coral 5
96. HPM X: Additive Manufacturing	S Pacific 1
97. COASTAL VIII: Coastal Erosion	S Pacific 2
98. OCEAN TECHNOLOGY XV: Panel	S Pacific 3
99. ADVANCED SHIP TECH X: Maneuvering	S Pacific 4
100. GEOTECH X: Soil-Pipeline Interactions	Sea Pearl 2-4
101. ARCTIC IV: Ice Management & DP	Nautilus Ste
16:20	
102. HYDRODYNAMICS XI: CFD 3 Ship Hydrodynamics	Coral 1
103. HYDRODYNAMICS XVII: Dynamic Positioning 1	Coral 2
104. RENEWABLE ENERGY XI: Offshore Wind 7: General	Coral 4
105. SUBSEA, PIPELINES, RISERS VIII: Umbilicals 2	Coral 5
106. HPM XI: EAC I: Hydrogen Embrittlement Fundame 1	S Pacific 1
107. COASTAL IX: Coastal Management	S Pacific 2
108. OMGH I - Gas Hydrates 1: Fundamental	S Pacific 3
109. ADVANCED SHIP TECH XI: Design & Production	S Pacific 4
110. GEOTECH XI: Ground Improvement	Sea Pearl 2-4
111. ARCTIC V: Ice Navigation	Nautilus Ste

<p>19:00 Coral, 6F</p> <p>The 29th Annual Conference Banquet</p> <p>Cultural Event, ISOPE Best Paper, Best Student Paper, Outstanding Student Scholarships, Best Organizer(s) and ISOPE Awards</p> <p><i>Don't forget the banquet ticket.</i></p>

THURSDAY JUNE 20

07:30 Session Chair/Co-chair Briefing	Coral Lounge, 6F
08:00	
112. HYDRODYNAMICS XII: CFD 4 Hydrodynamics 2	Coral 1
113. HYDRODYNAMICS XVIII: Dynamic Positioning 2	Coral 2
114. RENEWABLE ENERGY XII: Offshore Wind 8: General	Coral 4
115. SUBSEA, PIPELINES, RISERS IX: Multiphase Flow	Coral 5
116. HPM XII: EAC II: Hydrogen Embrittlement- Fundam2	S Pacific 1
117. OMGH II: Gas Hydrates 2	S Pacific 2
118. MECHANICS/COLLISION/RELIABILITY I: Hydroel	S Pacific 3
119. ADVANCED SHIP TECH XII: Squat, Operation	S Pacific 4
120. GEOTECH XII: Panel	Sea Pearl 2-4, 7F
121. ARCTIC VI: Ice Loads	Nautilus Ste
10:30	
122. HYDRODYNAMICS XIII: CCP-WSI Blind Tests 1	Coral 1
123. HYDRODYNAMICS XIX: Floating Tunnel, Bridge 1	Coral 2
124. RENEWABLE ENERGY XIII: Tidal & Current	Coral 4
125. SUBSEA, PIPELINES, RISERS X: Subsea Installation	Coral 5
126. HPM XIII: EAC III: Carbon Steel; Sour Performance 1	S Pacific 1
127. OMGH III: OCEAN MINING 1: Exploration & Environ	S Pacific 2
128. MECHANICS/COLLISION/RELIABILITY II: Impact	S Pacific 3
129. ADVANCED SHIP TECH XIII: Stability & Safety	S Pacific 4
130. OCEAN TECHNOLOGY XII: Deepwater Drilling 1	Sea Pearl, 7F
131. ARCTIC VII: Arctic Ship Design	Nautilus Ste, 6F
12:00 Student Forum: adv. reservation required	Hibiscus, 6F
13:10 Keynote	
World's First Massive Sulphides Lifting Test JOGMEC	S Pacific 2
14:00	
132. HYDRODYNAMICS XIV: CCP-WSI Blind Tests 2	Coral 1
133. HYDRODYNAMICS XX: Floating Tunnel, Bridge 2	Coral 2
134. RENEWABLE ENERGY XIV: Energy Storage	Coral 4
135. SUBSEA, PIPELINES, RISERS XI: Subsea	Coral 5
136. HPM XIV: EAC IV: Carbon Steel; Sour Performance 2	S Pacific 1
137. OMGH IV: OCEAN MINING 2: Environ & Mining	S Pacific 2
138. MECHANICS/COLLISION/RELIABILITY III: Risk	S Pacific 3
139. OCEAN TECHNOLOGY X: Structural Health 1	S Pacific 4
140. OCEAN TECHNOLOGY XIII: Deepwater Drilling 2	Sea Pearl
141. ARCTIC VIII: Arctic Shipping	Nautilus Ste, 6F
16:20	
142. HYDRODYNAMICS XV: CFD Modeling on FPSO	Coral 1
143. HYDRODYNAMICS XXI: Floating Tunnel 3 Panel	Coral 2
144. Renewable Energy XV: Panel	Coral 4
145. SUBSEA, PIPELINES, RISERS XII: Pipeline Mechanics	Coral 5
146. HPM XV: Panel	S Pacific 1
147. OMGH V: OCEAN MINING 3: Mining System	S Pacific 2
148. MECHANICS/COLLISION/RELIABILITY IV: Risk	S Pacific 3
149. OCEAN TECHNOLOGY XI: Structural Health 2	S Pacific 4
150.. OCEAN TECHNOLOGY XIV: Deepwater Drilling3	Sea Pearl,
151. ARCTIC IX: Emergency & Remote Sensing	Nautilus Ste

Sunday – Friday

Author Practice	Session rooms
On-site Registration	Coral Lounge, 6F
ISOPE Headquarters	S Pacific Boardroom, 7F
Proceedings Pickup	Registration Desk, Coral Lounge, 6F
Award, Editors Committee Meetings	Ilima Boardroom, 6F

Tours : <http://www.isopec.org/index.php/conferences-symposia-and-workshops/>

TECHNICAL PROGRAM

ISOPE-2019 Honolulu, Hawaii, USA The Twenty-ninth (2019) International Ocean and Polar Engineering Conference Honolulu, Hawaii, USA, June 16–21, 2019

This 28th annual conference features **151** technical and opening general sessions, **9** plenary presentation and keynote presentations from top experts from industry, academia and government. After peer review of the manuscripts selected from **1,300+** abstracts, **737** peer-reviewed-papers and additional 43 oral presentations only are accepted and discussions by researchers, engineers and managers from **50+** countries.

The ISOPE-2019 Conference Proceedings with peer-reviewed papers in PDF files will be available in a set of 4 volumes on USB (5,020 pp.) — paginated — during the conference and later for worldwide post-conference order from ISOPE: ISBN 978-1-880653-85-2; ISSN 1098-6189.

The number at end of the session title is the proceedings volume. Only the changes in titles or authors the Technical Program Committee received in writing before June 10, 2019 are reflected in this program. Final update is reflected in the Final Program.

All ISOPE publications are indexed by Engineering Index, EI Compendex, Google Scholar, Scopus, Scientific and Technical Proceedings (ISTP/ISI), Web of Science and others.

FULL CONFERENCE PROGRAM WITH SESSION / PAPER LIST:

Updates at

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127. OMGH III: OCEAN MINING 1: Exploration, Environ S Pacific 2
137. OMGH IV: OCEAN MINING 2: Environ & Mining S Pacific 2
147. OMGH V: OCEAN MINING 3: Mining System S Pacific 2

RENEWABLE ENERGY: OFFSHORE WIND AND OCEAN (Vol. 1)

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24. RENEWABLE ENERGY III: Wave Energy 3 Coral 4
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LNG, OFFSHORE MECHANICS, OCEAN TECHNOLOGY (Vol. 1)

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18. OCEAN TECHNOLOGY II: Installation 2 S Pacific 3
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38. OCEAN TECHNOLOGY IV: Floating Dynamics 1 S Pacific 3
48. OCEAN TECHNOLOGY V: Floating Dynamics 2 S Pacific 3
58. OCEAN TECHNOLOGY VI: Floating Dynamics 3 S Pacific 3
68. OCEAN TECHNOLOGY VII: Floating Dynamics 4 S Pacific 3
78. OCEAN TECHNOLOGY VIII: LNG, Bunkering 1 S Pacific 3
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111. ARCTIC V: Ice Navigation	Nautilus Ste
121. ARCTIC VI: Ice Loads	Nautilus Ste
131. ARCTIC VII: Arctic Ship Design0	Nautilus Ste

141. ARCTIC VIII: Arctic Shipping	Nautilus Ste
151. ARCTIC IX: Emergency & Remote Sensing	Nautilus Ste

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