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海洋科技专辑

内容提要

Statistical Characterization and Computationally Efficient Modeling of a Class of Underwater Acoustic Communication Channels

Numerical simulation of three dimensional cavitation shedding dynamics with special emphasis on cavitation-vortex interaction

2022 年海洋领域前沿科技发展态势及 2023 年趋势展望

世界海洋领域 2022 年态势总结：

（1）世界主要国家持续推进海洋防务装备研建进程，谋求全面提升海军实力。

（2）世界主要国家加强北极谋篇布局，全方位提升北极事务参与度。

（3）深海资源开发热度持续高涨，多国在深海装备与技术领域取得重要进展。

（4）主要造船国家致力于提升高技术船舶全球竞争力。

世界海洋领域 2023 年趋势展望：

（1）各国将持续加大在海洋防务装备领域的投入，推进相关装备更新换代与新研新建。

（2）北极形势愈发复杂，或将引发北极安全态势变化。

（3）深海基础设施安全问题愈发凸显，深海装备商业化进程有望进一步加快。

（4）高技术船舶迎来重要发展期，日欧韩将继续引领高技术船舶发展。

来源：搜狐网（全球技术地图），2023-01-29. https://www.sohu.com/a/635331072_120319119

◤ 从十八大、十九大、二十大报告看海洋政策变迁

十八大报告提及海洋的篇章是在“大力推进生态文明建设”，旨在强调提高海洋开发能力，开发海洋的同时做好海洋生态环境保护，开展基于生态系统保护的海洋开发利用。十九大报告提及海洋的篇章是在“贯彻新发展理念，建设现代化经济体系”，旨在强调海洋高质量发展，推进海洋科技在海洋资源开发、环境保护领域的支撑作用，推动海洋经济向质量效益型转变。二十大报告提及海洋的篇章是在“推进国家安全体系和能力现代化，坚决维护国家安全和社会稳定”，旨在强调未来要增强维护国家海洋权益安全能力，深度参与全球海洋治理。

来源：中国疏浚协会，2022-10-21. https://mp.weixin.qq.com/s?__biz=MzI5NTYwMTQzMA==&mid=2247511001&idx=4&sn=5cbd40905ec6f2ca5b26377e5f346228&chksm=ec53ffa0db2476b6f08c67ffbc128bad38453e48596ecd4082345b287f0e146402b2ffef3030&scene=27

◤ 工业和信息化部、国家发展改革委、国务院国资委关于巩固回升向好趋势加力振作工业经济的通知

巩固装备制造业良好势头。打好关键核心技术攻坚战，提高大飞机、航空发动机及燃气轮机、船舶与海洋工程装备、高端数控机床等重大技术装备自主设计和系统集成能力。实施重大技术装备创新发展工程，做优做强信息通信设备、先进轨道交通装备、工程机械、电力装备、船舶等优势产业，促进数控机床、通用航空及新能源飞行器、海洋工程装备、高端医疗器械、邮轮游艇装备等产业创新发展。发挥新能源汽车产业发展部际协调机制作用，突破关键核心技术，构建新型产业生态，完善基础设施建设，推动新能源汽车产业高质量可持续发展。组织农机装备补短板行动，一体化推动生产推广应用。加快能源电子产业发展，推动智能光伏创新发展和行业应用，完善光伏、锂电等综合标准化技术体系。优化实施首台（套）重大技术装备、重点新材料首批次保险补偿试点政策，深入开展政府采购支持首台（套）试点，推动首台（套）、首批次等创新产品研发创新和推广应用。

来源：中华人民共和国中央人民政府，2022-11-21. http://www.gov.cn/zhengce/zhengceku/2022-11/30/content_5729585.htm

◤ 中共中央、国务院印发《扩大内需战略规划纲要（2022-2035 年）》

《扩大内需战略规划纲要（2022-2035 年）》中指出，要推动区域协调发展完善内需增长空间格局，健全区际利益补偿等促进区域协调发展机制，积极拓展海洋经济发展空间；壮大战略性新兴产业，深入推进国家战略性新兴产业集群发展，建设国家级战略性新兴产业基地，促进重大装备工程应用和产业化发展。

来源：中华人民共和国中央人民政府，2022-12-14. http://www.gov.cn/gongbao/content/2023/content_5736706.htm

◤ 工业和信息化部关于公布 2022 年工业和信息化部重点实验室名单，3 个涉及海洋领域

依据《工业和信息化部重点实验室管理暂行办法》（工信部科〔2014〕515 号），经评审和公示，工业和信息化部公布 2022 年工业和信息化部重点实验室名单。其中哈尔滨工程大学的 3 所重点实验室均涉及海洋领域：海洋无人系统跨域协同与综合保障工业和信息化部重点实验室、水下推进技术工业和信息化部重点实验室以及海洋光子材料与器件物理工业和信息化部重点实验室。

来源：中华人民共和国中央人民政府，2023-01-05. http://www.gov.cn/zhengce/zhengceku/2023-01/17/content_5737538.htm

◤ 探极八万里 纵横三大洋——中国极地大洋科学考察成果综述

我国大洋活动空间不断拓展，在太平洋、印度洋的国际海底区域获得 5 块勘探合同区，总面积 23.5 万平方公里，为世界之最；资源环境调查勘探稳步推进，组织开展了近 80 个航次调查，形成了“多资源、多学科、多海域、多船作业”的调查格局；深海科学技术发展实现突破，调查取得的大量样品和资料，推动了深海地球科学发展，实现了深海找矿理论的突破，我国自主研发的“蛟龙”“深海勇士”“奋斗者”载人潜水器，“海龙”“海马”“潜龙”无人潜水器及深海浅钻、海底电视摄像、热液快速探测系统等调查装备已成为我国深海调查的主力，深海矿产资源开发及选冶加工与综合利用技术部分领域进入世界前列；国际海域事务深度介入，参与了《联合国海洋法公约》等国际规则的讨论和制定，全面参与国际海底管理局建设，从规则适应者成为主要参与者和倡导者，我国专家连续当选国际海底管理局法律技

术委员会和财务委员会委员，中国提交的 100 余个命名提案通过国际海底地理实体命名委员会审查，中华元素和影响得到体现；综合保障能力不断增强，《中华人民共和国深海海底区域资源勘探开发法》颁布实施，配套法规体系建设逐步完善，大洋调查船队已具规模，中国大洋样品馆等综合支撑平台实现业务化运行。

来源：中华人民共和国自然资源部，2023-01-19. https://www.mnr.gov.cn/dt/ywbb/202301/t20230119_2774416.html

◤ “奋斗者”号再探底！首次抵达蒂阿蔓蒂那海沟最深点

1 月 22 日，“探索一号”科考船搭载“奋斗者”号全海深载人潜水器，在位于东南印度洋蒂阿蔓蒂那海沟最深点完成深潜作业后，成功回收。这是人类历史上首次抵达该海沟的最深点。2022 年 10 月 6 日，由中科院深海所牵头组织实施，来自上海交大、同济大学等高校共计 56 名参航队员组成的深渊科考队，从三亚启航，前往克马德克海沟完成了两个航段的科考作业。目前正在蒂阿蔓蒂那海沟执行第三个航段的深渊探测作业。这是“奋斗者”号全海深载人潜水器正式投入使用以来，第一次抵达东南印度洋作业。在完成在克马德克海沟的中新联合科考活动后，目前继续对蒂阿蔓蒂那海沟底部的地质、环境和生物过程开展系统的观察和研究。

来源：央广网，2023-01-22. https://baijiahao.baidu.com/s?id=1755703957883323150&wfr=spider&for=pc

◤ 新一代海洋漂流浮标研制成功，可随时自主加密观测

在联合国“海洋十年”海洋与气候无缝预测（OSF）大科学计划支持下，自然资源部第一海洋研究所科研团队成功研制出低成本、高精度、智能型的新一代全球导航卫星系统（GNSS）海洋表层漂流浮标，为大幅提升海洋观测和监测能力提供了新的重大契机。海洋一所表示，研发的新型 GNSS 浮标具有智能性，可以根据客观需求（比如大浪区、内波、海洋灾害等）随时自主加密观测。未来通过进一步技术攻关，还可能探测涡旋以及精密测量全球的潮位等，从而加强对全球沿海地区的保护。

来源：新京报，2023-02-06. https://m.bjnews.com.cn/detail/167567238114814.html

◤ 国家海洋信息中心牵头国家重点研发计划“海洋环境安全保障与岛礁可持续发展”专项两项目启动

国家海洋信息中心牵头的“十四五”国家重点研发计划“海洋环境安全保障与岛礁可持续发展”专项“基于大数据和人工智能的海洋环境快速预报技术研究与应用”和“海洋环境安全风险感知与应急决策服务关键技术及装备研发”项目启动会暨实施方案论证会在天津成功召开。“海洋环境安全风险感知与应急决策服务关键技术及装备研发”项目由国家海洋信息中心牵头，联合清华大学、自然资源部第一海洋研究所、国家海洋环境预报中心和北京辰安科技股份有限公司等 10 家单位承担实施。项目面向基层应急能力提升的国家重大需求，在“十三五”研发的国家海洋环境安全保障平台基础上，重点针对海上油气资源开发区、海水养殖区、港口码头区、海洋生态保护区和沿海社区等，突破陆海承灾体与海洋环境安全事件智能感知解译、多事件多承灾体安全态势综合评估、多主体协同应对智能决策和推演仿真等关键技术，构建海洋环境安全风险感知与应急决策服务系统装备，实现典型用户场景应用示范。

来源：海洋知圈，2023-02-07. https://www.163.com/dy/article/HT0QBHEA0511KMS0.html

◤ AUV Navigation and Localization: A Review

作者：Paull L., Saeedi S., Seto M., Li H.

来源：Ieee Journal of Oceanic Engineering, v: 39, i: 1, p: 131-149. 2014

摘要：Autonomous underwater vehicle (AUV) navigation and localization in underwater environments is particularly challenging due to the rapid attenuation of Global Positioning System (GPS) and radio-frequency signals. Underwater communications are low bandwidth and unreliable, and there is no access to a global positioning system. Past approaches to solve the AUV localization problem have employed expensive inertial sensors, used installed beacons in the region of interest, or required periodic surfacing of the AUV. While these methods are useful, their performance is fundamentally limited. Advances in underwater communications and the application of simultaneous localization and mapping (SLAM) technology to the underwater realm have yielded new possibilities in the field. This paper presents a review of the state of the art of AUV navigation and localization, as well as a description of some of the more commonly used methods. In addition, we highlight areas of future research potential.

全文链接：https://ieeexplore.ieee.org/document/6678293

◤ Human-Visual-System-Inspired Underwater Image Quality Measures

作者：Panetta K., Gao C., Agaian S.

来源：Ieee Journal of Oceanic Engineering, v: 41, i: 3, p: 541-551. 2016

摘要：Underwater images suffer from blurring effects, low contrast, and grayed out colors due to the absorption and scattering effects under the water. Many image enhancement algorithms for improving the visual quality of underwater images have been developed. Unfortunately, no well-accepted objective measure exists that can evaluate the quality of underwater images similar to human perception. Predominant underwater image processing algorithms use either a subjective evaluation, which is time consuming and biased, or a generic image quality measure, which fails to consider the properties of underwater images. To address this problem, a new nonreference underwater image quality measure (UIQM) is presented in this paper. The UIQM comprises three underwater image attribute measures: the underwater image colorfulness measure (UICM), the underwater image

sharpness measure (UISM), and the underwater image contrast measure (UIConM). Each attribute is selected for evaluating one aspect of the underwater image degradation, and each presented attribute measure is inspired by the properties of human visual systems (HVSs). The experimental results demonstrate that the measures effectively evaluate the underwater image quality in accordance with the human perceptions. These measures are also used on the AirAsia 8501 wreckage images to show their importance in practical applications.

全文链接：https://ieeexplore.ieee.org/document/7305804

◤ Realistic wave generation and active wave absorption for Navier-Stokes models Application to OpenFOAM (R)

作者：Higuera P., Lara J. L., Losada I. J.

来源：Coastal Engineering, v: 71, p: 102-118. 2013

摘要：The present paper and its companion (Higuera et al., 2012) introduce OpenFOAM (R) as a tool to consider for coastal engineering applications as it solves 3D domains and considers two-phase flow. In this first paper, OpenFOAM (R) utilities are presented and the free surface flow solvers are analysed. The lack of specific boundary conditions for realistic wave generation is overcome with their implementation combined with active wave absorption. Wave generation includes all the widely used theories plus specific piston-type wavemaker replication. Also standalone active wave absorption implementation is explained for several formulations, all of which are applicable to 3D cases. Active wave absorption is found to enhance stability by decreasing the energy of the system and to correct the increasing water level on long simulations. Furthermore, it is advantageous with respect to dissipation zones such as sponge layers, as it does not increase the computational domain. The results vary depending on the theory (2D, Quasi-3D and 3D) but overall performance of the implemented methods is very good.

全文链接：https://doi.org/10.1016/j.coastaleng.2012.07.002

◤ Statistical Characterization and Computationally Efficient Modeling of a Class of Underwater Acoustic Communication Channels

作者：Qarabaqi P., Stojanovic M.

来源：Ieee Journal of Oceanic Engineering, v: 38, i: 4, p: 701-717. 2013

摘要：In this paper, we offer a statistical channel model which incorporates physical laws of acoustic propagation (frequency-dependent attenuation, bottom/surface reflections), as well as the effects of inevitable random local displacements. Specifically, we focus on random displacements on two scales: those that involve distances on the order of a few wavelengths, to which we refer as small-scale effects, and those that involve many wavelengths, to which we refer as large-scale effects. Small-scale effects include scattering and motion-induced Doppler shifting, and are responsible for fast variations of the instantaneous channel response, while large-scale effects describe the location uncertainty and changing environmental conditions, and affect the locally averaged received power. We model each propagation path by a large-scale gain and micromultipath components that cumulatively result in a complex Gaussian distortion. Time-and frequency-correlation properties of the path coefficients are assessed analytically, leading to a computationally efficient model for numerical channel simulation. Random motion of the surface and transmitter/receiver displacements introduce additional variation whose temporal correlation is described by Bessel-type functions. The total energy, or the gain contained in the channel, averaged over small scale, is modeled as log-normally distributed. The models are validated using real data obtained from four experiments. Specifically, experimental data are used to assess the distribution and the autocorrelation functions of the large-scale transmission loss and the short-term path gains. While the former indicates a log-normal distribution with an exponentially decaying autocorrelation, the latter indicates a conditional Ricean distribution with Bessel-type autocorrelation.

全文链接：https://ieeexplore.ieee.org/document/6616000

◤ Numerical simulation of three dimensional cavitation shedding dynamics with special emphasis on cavitation-vortex interaction

作者：Ji B., Luo X. W., Arndt R. E. A., Wu Y. L.

来源：Ocean Engineering, v: 87, p: 64-77. 2014

摘要：Recent experiments showed that there is an interaction between the fluid vortex formation and cavitation, but the mechanism is still an open problem. In the present paper, the structure of the cavitating flow around a twisted hydrofoil was investigated numerically using the mass transfer cavitation model and the modified RNG k-epsilon model with a local density correction for turbulent eddy viscosity. The predicted three dimensional cavity structures and the shedding frequency agree fairly well with experimental observations. Three types of flow behavior along the suction side of the twisted hydrofoil are discussed. Further analysis of the flow field reveals that cavitation promotes vortex production and increases the boundary layer thickness with local separation and the flow unsteadiness. Finally, the influence of cavitation on the vorticity distribution is illustrated using the vorticity transport equation in a variable density flow and is demonstrated by the contribution of vortex stretching, vortex dilatation and baroclinic torque terms。

全文链接：https://doi.org/10.1016/j.oceaneng.2014.05.005

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