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14. ABSTRACT
The sub-discipline of ocean optics is an exciting and equally challenging field, as the scattering and absorption agents in the water, and the water itself, severely limits that range of optical reach when compared to the in-air systems. Optical methods provide the only means to penetrate the ocean from space. In this section, we examine the latest development in underwater imaging, ocean color remote sensing and lidar, through measurements and models.

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Ocean Optics

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The subdiscipline of ocean optics is an exciting and equally challenging field, as the scattering and absorption agents in the water, and the water itself, severely limit the range of optical reach when compared to in-air systems. A typical range reduction factor of 1000:1 is often used as a crude estimation of optical range in water. Extending beyond this range often requires dedicated design and postprocessing systems. The same can be said of the preservation of spatial resolution under these conditions.

Several papers in this special section take on these challenges directly in terms of enhancing underwater imaging and communication system performance. Different approaches have been applied, including using RF modulated pulses to better eliminate scattered photons (S. O'Connor et al.); enhanced optical sensing range accuracy in the meantime in a hybrid approach (R. W. Lee et al.); better suppression of forward-scattered photons with high-frequency modulation (B. Cochenour et al.); and a new class of laser line-scanning system taking advantage of compressive sensing imaging techniques (B. Ouyang et al.). Modeling is key in system design and performance estimation. A physical simulator for optical communication systems is a great example of that (F. R. Dalgleish et al.).

Ocean color remote sensing provides synoptic views of the near-surface returns from the ocean, and can provide much-needed knowledge in monitoring coastal environments (C. Hu et al.). However, due to the passive nature of the approach, it is prone to the effects of other environmental forcing besides the desired components, such as aerosol contributions, which can attribute up to 90% of the detected signals at the sensor level for the space-borne platforms. Other factors such as surface specular reflectance or location of the sun can also pose challenges in data retrieval. Subsurface irradiance variations induced by the sea surface can be problematic, especially when the sampling footprint is small, such as those related to calibration/validation efforts. The effect has been simulated using a Monte Carlo method (Z. Xu and D. K. P. Yue). Active sensing by the means of lidar eliminates many of the issues, however. These are discussed in depth in the review paper by J. H. Churnside, along with various designs and property retrieval algorithms. Lidar provides the only means of penetration into the ocean subsurface layers, which is critical in a myriad of applications ranging from ocean sensing and modeling, to momentous exchange between the atmosphere and the ocean and related CO_2 distributions which influence global climate change, to defense applications in mine countermeasures and antisubmarine warfare. It is exciting to see that the Brillouin lidar technique in sensing the subsurface temperature and sound velocity has matured enough to provide the needed accuracy on the order of 0.07 degrees (A. Rudolf and T. Walther).

Topics in the ocean optics field most definitely involve multiple disciplines, due to the nature of the subject and its spatial as well as temporal variability under observation. It is my hope that highlighting some of the recent advances from this field will help to excite new and renewed interest in this challenging area.

Weilin "Will" Hou is an oceanographer at the U. S. Naval Research Laboratory and manages the Hydro Optics, Sensors and Systems Section. He received his PhD from the College of Marine Science, University of South Florida in 1997. His research interests include ocean optics, underwater imaging, optical turbulence, remote sensing including LiDAR, numerical simulation, data management, instrumentation, and platforms, including unmanned aerial and underwater vehicles. He organizes the Ocean Sensing and Monitoring conference as part of the SPIE Defense and Security Symposium, and he teaches a short course on the related topics. He is a Fellow of SPIE.