Manipulating Light Waves: introduction

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This special Applied Optics issue pays tribute to an extraordinary teacher, scientist, and friend who revolutionized several fields of optics, such as holography, microscopy, and biomedical imaging, by contributing his unique and simplified perspective on complicated phenomena. We thank all the authors who have contributed papers to this special feature as a manifestation of the long and unique career of Emmett Leith. © 2008 Optical Society of America

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It is an honor to pay tribute to Emmett Leith with a sampling of current research from areas in which he pioneered, a fitting testimony to his influence on modern optical science. Emmett left an indelible mark on optics, contributing a multitude of seminal advances. Personally, he had a fiercely independent intellect and a lust for objective knowledge. As an educator, he inspired his students with penetrating and enthusiastic lectures. Many in the optics community have been influenced by Professor Leith, and to capture this sentiment, one of us (Caulfield) has put together a short reflection on interactions with Emmett, which appears as a brief note following this introduction.

The response to the feature announcement was impressive, to the extent that Emmett himself would surely have been interested in this issue. Of all the areas Emmett investigated, certainly holography has been the most influential [1–3]. Considering contemporaneous developments in areas related to Emmett’s holography work, the cumulative influence is vast. The paper on quantum communications from Mark Gruneisen’s group at the United States Air Force Research Laboratory exemplifies the exciting new areas to which the foundational developments of Emmett Leith and his contemporaries are being applied. The paper by Hans Bjelkhagen’s group provides historical perspective into Emmett’s influence on display holography, as well as extending into current topics and remarkable examples of color realism.

Emmett Leith came upon his remarkable approach to holography while working on optical information processing of synthetic-aperture-radar (SAR) data [4]. Emmett’s work served as an impetus for the field of coherent optical processing, which remains vibrant more than four decades after his seminal contributions. Building on his investigations of achromatic holography and optical processing [5,6] and use of grating interference to image through scattering media with a low temporal coherence source [7], Emmett applied ultrafast optical pulses to techniques such as “light-in-flight” and “first-arriving-light” holography [8,9]. Temporal control of ultrafast pulses is a robust subfield of coherent optical processing well represented in the feature issue with papers from Andrew Weiner’s group at Purdue and Shaya Fainman’s group at University of California, San Diego, presenting recent advances in coherent control of ultrafast and RF waveforms.

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Emmett Leith pioneered in other areas only tangentially related to holography. His early use of lasers highlighted the importance of speckle as a trade-off for coherence [10]. It was soon appreciated that mathematical models of speckle were essential to the design and analysis of systems utilizing coherent light. Joseph Goodman at Stanford and Nicholas George at Rochester contributed some of the most important early treatments of speckle, and their contributions to the feature issue demonstrate the continued demand to understand speckle phenomena. Emmett Leith also investigated various speckle-mitigation techniques for imaging and microscopy [8,10–12], and with the computer revolution he was quick to apply digital recording and processing to these techniques. The techniques that Emmett pioneered led to many of today’s technologically relevant imaging modalities, particularly those in biomedical optics. At around the same time that they were developing time-resolved imaging techniques [8,9], Emmett’s group was also demonstrating variations on the theme of confocal imaging [13,14]. They had therefore developed, as much as anyone else, the two main components of optical coherence tomography (OCT). For the feature issue, Joseph Shamir’s group at Technion presents an investigation of a novel technique for nanoscale microscopy, reminiscent of several papers by Emmett’s groups over the years [15–17], and Gert von Bally’s paper presents techniques that neatly integrate three areas to which Emmett contributed: holography, microscopy, and biomedical optics.

We thank all the authors who contributed to the feature issue. The expanding research and development of these authors and their peers is the real eternal tribute to the great Emmett Leith.

References
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