

Introduction to the Special Issue on Acoustic Metamaterials

The field of acoustic metamaterials is a relatively new topic in applied physics that has broad appeal in the scientific community because of the potential for realizing physical phenomena that had previously been deemed impossible. Acoustic metamaterials have been proposed to achieve both exotic behavior, such as acoustic cloaks and sub-wavelength resolution acoustic lenses, and to enhance engineering performance in areas like acoustic isolation, absorption, and transmission. Generally, acoustic metamaterials are material systems whose overall performance originates from engineered sub-wavelength structure rather than the inherent material properties of their constituents. They are to some extent inspired by analogous work in the last decade in the field of electromagnetics. For this reason, early research on acoustic metamaterials borrowed heavily from electromagnetic analogies or even direct “translation” of field equations describing electromagnetic phenomena into the acoustic domain. The field has since expanded to include contributions from many researchers with expertise in the areas of acoustic and elastic waves, composite materials, materials science, and related fields. It is only appropriate, then, that this special issue contains articles that reflect the wide array of acoustical phenomena made possible through these structured materials. The topics covered include: resonant metamaterials, super-resolution imaging, negative refraction, acoustic gradient index lensing; negative density and elastic modulus, effective dynamic properties; periodic frame structures; anisotropic, nonlinear and electromagnetically controlled acoustic metamaterials; imperfections, attenuation and cavity resonances in sonic crystals; transformation methods for acoustic and elastic waves, and acoustic cloaks.

From the outset, the objective of the issue was to provide an opportunity for both contributors and the readership of the Journal to explore this new topic. We noted that most publications on acoustic metamaterials to date are not in the Journal of the Acoustical Society of America (JASA), despite the fact that acoustic metamaterials rely on wave phenomena familiar to many who consider acoustics their primary field of expertise. This issue therefore provides a means to reach individuals in the Society who may have heard of acoustic metamaterials but are unfamiliar with the quality of research in the area and the far-reaching implications of the topic. Conversely, many who contributed to this issue are not regular contributors to JASA. This issue provides these authors with a platform to present their work to the acoustics community. In both regards, we hope that this special issue sparks new ideas for research in this new and exciting field.

As Guest Editors, we would like to thank the editorial staff for their assistance in putting the special issue together in accordance with the standards of the Journal. We would also like to thank the Editor in Chief, Allan Pierce, for his encouragement and advice. Finally, we would like to extend a special thanks to all of the contributors and reviewers who provided high quality manuscripts that clearly display the breath of ongoing research in the field of acoustic metamaterials. We hope that this collection stimulates further contributions to the Journal.

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