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Guest Editorial

Special Section on the Dynamics of MEMS and NEMS

Since the pioneering work of Harvey Nathanson and his collaborators in the mid-1960s, microelectromechanical systems (MEMS) that leverage dynamic behavior for practical purpose have been of distinct research interest [1,2]. From roughly 1980 to 2000, research in this area grew appreciably, paced by advancements in the integrated circuit community and fueled by the promise of resonant microsystems in applications ranging from chemical, biological, and inertial sensing to atomic force microscopy and radio frequency signal processing. While this measurable growth was largely spurred on by researchers with circuits and systems expertise, the early 2000s saw an influx of biologists and physicists into the research area, rightly drawn to the topic by the potential of exploring the very foundations of their own fields with these small-scale devices.

The early 2000s also saw an influx of dynamicists and vibration engineers into the research space. These researchers, much like ourselves, were drawn not only by the potential noted previously but also by the richness of behavior exhibited by MEMS and their nanoscale brethren, nanoelectromechanical systems. This richness stemmed from the small-scale systems' often-multiphysical transduction mechanisms; inherent geometric, inertial, dissipative, and field-derived nonlinearities that could not be easily circumvented in practice; and complicating, yet very real, factors such as noise and uncertainty.

In recent years, research related to each of the aforementioned topics has been detailed extensively in a multitude of excellent journal and conference publications as well as a number of seminal reviews, research monographs, and textbooks (see, for example, Refs. [3–16]). It is not practical for this editorial to recap such a large field of research, rather this brief statement is intended to serve as an introduction to the handful of works that follow, which contribute to the ever-growing body of knowledge in this area and provide a snapshot of the high-quality research advancements being made in this field in the year 2017. The subjects described in the following papers cover a representative variety of topics related to the modeling, design, analysis, measurement, and application of small-scale structures. They portray the dynamic response of microscale systems in the forms of curved plates, clamped–clamped beams, arches, frames, and ring and wineglass resonators used in vibratory gyroscopes, and describe a variety of phenomena and design tools such as primary and parametric resonances, synchronization, design with uncertainty and imperfections, response to stochastic fluctuations, response to transient inputs, and nonlinear damping. We hope that you, the reader, will enjoy reading these works and will perhaps be inspired to pursue a research problem in this rich and continually expanding field.

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