Computational Mechanics of Electro-Active Materials

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Aim: This mini-symposium aims to bring the researchers together from different sub-disciplines of computational engineering sciences by providing a common discussion platform for exchanging ideas on the latest developments in the computational mechanics of electro-active materials.

Motivation: The phrase "electro-active material" is intended to refer to a broad class of materials that actively responds to an externally applied or intrinsically generated electric field by undergoing remarkable deformations. Similarly, they might also generate an electric activity as subjected to a mechanical loading. Electro-active materials are not restricted to man-made products such as piezoelectrics, ferroelectrics, dielectric polymers but also cover a wide range of bio-materials, like cardiac tissue. Synthetically produced electro-active materials have a wide spectrum of applications including high-tech devices, bio-medical products, artificial muscles. The optimum design and successful manufacture of these synthetic materials invariably necessitate accompanying quantitative computational analyses of the products that commonly possess complex geometries. The computational modeling of electro-active biological tissue, on the other hand, plays a key role in guiding patient-specific therapies such as surgical operations, novel stem cell-based treatments of infarcted cardiac tissue when the experimental techniques fall short. Advances in computational modeling of these seemingly distinct classes of materials can, of course, mutually and positively influence each other towards the development of artificial organs and design of bio-inspired functionally-optimized high-tech devices.

Focus: The emphasis of this mini-symposium is focused on, but not necessarily restricted to, the following areas:

- Theoretical and computational modeling of electo-active materials (thermodynamical considerations, variational aspects, generalized non-linear field equations, algorithmic procedures for time-stepping, and operator split methods, to name a few.)
- Computational modeling of failure mechanisms and fracture mechanics of electro-active materials and active nano-composites
- Computationally guided design of functionally optimized electro-active materials
- Computational modeling of electro-active biological tissues such as natural and artificial muscle, retina, and cardiac tissue
- Incorporation of couplings beyond the electro-mechanical and mechano-electrical effects such as thermal, magnetic, chemical fields