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Uncertainty Quantification in Biomechanics

Scientific area: Computational Solids And Structural Mechanics

With the strong inclination towards data-informed computational approaches in the development of population-specific and image-based biomechanical models, challenges in selecting representations and identifying their parameters have become increasingly formidable. Specialists are confronted with the incorporation of high-dimensional, scarce, and noisy datasets into complex computational models from which diagnostic or intervention-related conclusions are drawn. Statistical methods are thus pivotal to maximizing the utility of available data. Demonstrated applications include the development of inverse computational models, constitutive law selection and parameter identification, and determining corresponding confidence intervals. Quantifying such uncertainty remains a challenge, one which overcoming will facilitate making evidence-based modeling choices, and ultimately, evidence-based clinical decisions.

This mini-symposium will gather researchers tackling aspects of uncertainty quantification within biomechanics. Topics encompass the employment of statistical and numeric methods in the construction of inverse computational models, image-based characterization of in-vivo strain, and population-based constitutive model selection and parameter identification. The talks aim to present methods of direct pertinence to researchers and industry leaders alike, and emphasize the significance of a multidisciplinary approach in innovatively solving clinical challenges. Topics of interest include:

- Computational and statistical techniques in uncertainty quantification in biomechanics
- Inverse problems in biomechanics and optimization approaches
- Design and selection of suitable experimental methods for soft tissue characterization
- Applications of artificial intelligence and data-based approaches to biomechanical constitutive modeling and cardiovascular imaging
- Image registration and processing methods in deriving tissue strain and deformation measures

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