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강연제목: 피부 역학의 전산 모델링과 이를 활용한 불확정성 분석

(Computational modeling of skin mechanics and uncertainty analysis in mechanical and biological response of skin)

Abstract: Mechanical stress plays a significant role in wound healing, and excessive tension at the sutures of a wound leads to complications such as tissue necrosis or hypertrophic scarring. Yet, despite of this concern, there is limitation of the current clinical practice stems in part from the difficulty in directly measuring stress in the operating room, which is not practically feasible beyond ideal clinical cases. In addition, each patient requires a unique procedure, has individual skin mechanical properties and individual healing response, and stress distributions in complex surgeries are not intuitive. Computational modeling of soft tissues is a powerful tool to determine stress contours over sizable skin regions in realistic situations. However, to enable the use of virtual surgery models to improve surgical planning, fundamental research is needed to better understand the role of mechanical cues in the scarring response, and to account for uncertainty in the prediction of computational models for soft tissues. In order to achieve the overall goal, advances in several areas of computational biomechanics are needed: i) measuring patient-specific geometries and mechanical properties with flexible and inexpensive tools to easily create personalized models, ii) quantifying skin growth induced by tissue expansion before surface reconstruction, and iii) accounting for uncertainty in the mechanical behavior and biological response. In this talk, we will first discuss how these fundamental advances are achieved through computational mechanics and simulation such as finite element method and Bayesian surrogate modeling. Then, mechanical characterization of skin properties using suction test will be presented as an example to show how computational mechanics and simulation can derive a solution.

Brief Biosketch

Dr. Taeksang Lee is an assistant professor of the Department of Mechanical Engineering at Myongji University. He received his B.S. and M.S. degrees in Mechanical Engineering from Sungkyunkwan University in 2014 and 2016, respectively, and Ph.D. degree in Mechanical Engineering from Purdue University in 2020. During PhD study, Taeksang has worked on modeling biological tissue mechanics, growth and remodeling under uncertainty, as well as integration of computational mechanics with machine learning. Prior to joining the mechanical engineering faculty at Myongji University in the fall of 2021, he was a Research Staff Engineer at Samsung Electronics Mechatronics R&D Center. Taeksang's research at Myongji University is divided into three core topics: 1) Surrogate modeling through Bayesian inference, 2) theory and numerical characterization of incompatibility induced by tissue growth, and 3) constitutive-model-free data-driven computational mechanics.