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臺灣大學應用力學研究所

演 講 公 告

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主 講 人：劉立偉助理教授

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講　　題：心臟腱索與仿生材料的黏彈性力學研究

主 持 人： 陳建彰教授

時　　間： 111年11月28日（星期一）下午2時20分開始

地　　點： 臺灣大學應用力學研究所國際會議廳

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心臟腱索與仿生材料的黏彈性力學研究

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Abstract

In the first part of the present study, we investigate the mechanical behavior of the chordae tendineae which connects the papillary muscles to the mitral or tricuspid valve leaflets to prevent leaflet prolapse into the atria during systolic closure, ensuring a unidirectional blood flow through the heart chambers over the cardiac cycle. This biological soft tissue behaves viscoelastic features. Therefore, we theoretically establish a nonlinear viscoelastic model to describe the mechanical behavior of the TV chordae tendineae. This model is called nonlinear generalized Kelvin (NGK) model via a nonlinear spring is installed to replace the linear spring of the generalized Kelvin model. Its exact solutions with initial condition to the constant force/displacement, the constant-rate force/displacement, and the cyclic loading was obtained and the exact solution enable us to develop the identification of model parameters. The comparison between experimental results and the simulations of the NGK model shows it has capability to describe the viscoelastic behavior of the TV chordae tendineae. Besides the biological soft tissue behaves viscoelastic characteristics, compressive biological materials also exhibit creep and relaxation and most biological materials own attractive properties such low density with high stiffness and significantly better performance than their separate constituents due to their microstructures. In the second part of the present study, we therefore focus on the viscoelastic behavior of two bio-inspired materials with special microstructures. The viscoelastic properties of the 2D cellular materials called honeycomb materials, which imitate the microstructures observed from wood, cork, bone, and honeybees' honeycomb, is researched. On the other hand, viscoelastic features of the nacre-like material, which mimics the microstructures existed in nacre, bone, and dentine, is explored. The viscoelastic models of the two bio-inspired materials are proposed and the exact solutions under different loadings are obtained. Therefore, the mechanical behavior of the two inspired materials is investigated according to the exact solution.