

Mesh-free Method for Buckling and Vibration of Microtubules Based on a Higher-order Continuum Model

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A microtubule is treated as a higher-order continuum cylindrical tube, and a higher-order constitutive model is derived to study the mechanical property of microtubules. The representative cell is chosen as a triangle unit that contains two tubulin monomers and one guanosine triphosphate or guanosine diphosphate molecule. The appropriate potential functions are used to describe the interactions between the longitudinal and circular monomers, and the higher-order model is achieved using the higher-order Cauchy-Born rule in which the nonlinear response of microtubules can be displayed. A mesh-free method is developed to implement the global numerical simulation of microtubules. The buckling and vibration of microtubules are modeled with the developed mesh-free method, and some significant phenomena are discovered.

Keywords: Microtubules, Higher-order model, Mesh-free method, Buckling, Vibration