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Contact-Impact Analysis of Continuum Compliant Athletic Systems

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Abstract : Proper understanding of the behavior of compliant mechanisms use by athletes is important in order to avoid catastrophic failure. Such compliant mechanisms like the flex-run require the knowledge of their dynamic response and deformation behavior under quickly varying loads. The modeling of finite deformations of the compliant athletic system is described by Neo-Hookean model under contact-impact conditions. The dynamic impact-contact governing equations for both the target and impactor are derived based on the updated Lagrangian approach. A method where contactor and target are considered as a united body is applied in the formulation of the principle of virtual work for the bodies. In this paper, methods of continuum mechanics and nonlinear finite element method were deployed to develop a model that could capture the behavior of the compliant athletic system under quickly varying loads. A hybrid system of symbolic algebra (AceGEN) and a compiled back end (AceFEM) were employed, leveraging both ease of use and computational efficiency. The simulated results reveal the effect of the various contact-impact conditions on the deformation behavior of the impacting compliant mechanism.

Keywords : eigenvalue problems, finite element method, robin boundary condition, sturm-liouville problem
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