

On the Dynamics of Axially Moving Strings



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Cuvillier Verlag Aug 2007, 2007. Taschenbuch. Book Condition: Neu. 211x147x9 mm. Neuware - The primary objective of this thesis is to provide a coherent and concise elaboration of the modeling and analysis of axially moving strings. Both analytical and numerical solution techniques are used to study the free vibrations of strings in stationary and accelerated motion. Axially moving continua are prevalent in many engineering applications such as power transmission belts, magnetic tapes, elevator and crane hoist cables, band saw blades, and textile-fiber manufacture. During the past several decades, those systems have been extensively studied by many researchers, frequently referring to the translating uniform string as the simplest representative of distributed gyroscopic systems. This thesis addresses the modeling and analysis of strings moving axially between fixed supports. First, the problem of stationary motion is defined, and it is demonstrated that a perfectly flexible string can undergo a snake-like motion, that is, a motion along an arbitrary fixed path in space, only at constant speed. Along a straight line, however, motion at time-varying speed is feasible. For this special case, the linearized equation governing the transverse vibrations of an axially accelerated string is derived in both Lagrangian and Eulerian description by superposing small perturbations on the stationary solution. As the resulting equation of motion reveals a conflict with the one commonly referred to in literature, a comparison of both models is given including a physical interpretation of the well-known, but apparently incorrect equation. Also a numerical stability analysis based on Floquet's theory is presented. It is well-known that mechanical structures which can vibrate about a state of mean rotation or translating may constitute gyroscopic dynamic systems that are related by the mathematical similarity of their governing equations of motion. Considering as examples a rotating circular ring and an axially moving straight string,...

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