Wave propagation in axially moving periodic strings

The paper deals with analytically studying transverse waves propagation in an axially moving string with periodically modulated cross section. The structure effectively models various relevant technological systems, e.g. belts, thread lines, band saws, etc., and, in particular, roller chain drives for diesel engines by capturing both their spatial periodicity and axial motion. The Method of Varying Amplitudes is employed in the analysis. It is shown that the compound wave traveling in the axially moving periodic string comprises many components with different frequencies and wavenumbers. This is in contrast to non-moving periodic structures, for which all components of the corresponding compound wave feature the same frequency. Due to this "multi-frequency" character of the wave motion, the conventional notion of frequency band-gaps appears to be not applicable for the moving periodic strings. Thus, for such structures, by frequency band-gaps it is proposed to understand frequency ranges in which the primary component of the compound wave attenuates. Such frequency band-gaps can be present for a moving periodic string, but only if its axial velocity is lower than the transverse wave speed, and, the higher the axial velocity, the narrower the frequency band-gaps. The revealed effects could be of potential importance for applications, e.g. they indicate that due to spatial inhomogeneity, oscillations of axially moving periodic chains always involve a multitude of frequencies.