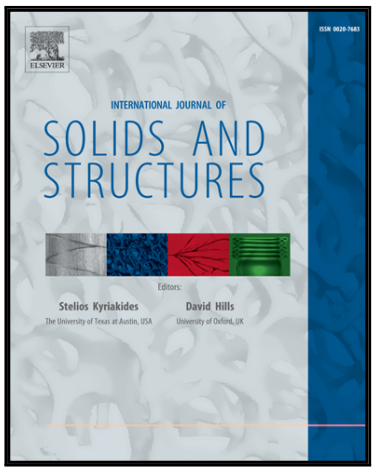


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# Transient wave in a transformable periodic flexural structure

M.J. Nieves[*], G.S. Mishuris[†] and L.I. Slepyan[‡]

**Abstract**

The analysis of a transition wave propagating in a finite heterogeneous discrete beam strip, composed of periodically placed masses and subjected to a harmonic load is presented. The load is assumed to be located sufficiently far away from the transition front. As waves propagate inside the structure, connections are broken and we investigate how this process evolves from the transient regime to the steady-state regime. It is found that the steady-state speed of this transition process, in the averaged sense, coincides with the predicted phase speed of the transition wave. For a given heterogeneity, we show that a transition wave can propagate steadily if the load amplitude and frequency are situated in a parameter subdomain. The steady-state regime does not exist outside of this domain. At a given load frequency, it is demonstrated that the average speed of fracture is independent of the load amplitude within a given steady-state domain and the number of such domains depends on the load frequency and structural heterogeneity. During the transition process, we identify several dynamic effects, including regimes where waves can be transmitted ahead of the front into the structure and the development of an inclination that follows the transition front in the steady-state regime. The occurrence of such effects and their behaviour also correspond to predictions from the theory. We show although the theoretical steady-state fracture regimes are realised globally, locally the fracture speed always behaves in a regular fashion.

## 1 Introduction

In contrast to the studies on mass-spring structures, to the best of the authors' knowledge dynamic transition wave propagation in beam structures has only been considered in a few articles. We refer to [7, 25] where transition wave propagation was studied in heavy supported beams and the failure phenomenon associated with the San Saba bridge was considered. In particular, in [26], several theoretical results concerning the propagation of a failure wave in an infinite beam structure, produced by a remote sinusoidal load, were obtained. The transition process is represented by the failure of members forming the supports in the

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