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BLOCH THEOREM WITH REVISED BOUNDARY CONDITIONS APPLIED TO GLIDE PLANE AND SCREW AXIS SYMMETRIC, QUASI-ONE-DIMENSIONAL STRUCTURES

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Bloch theorem provides a useful tool to analyze wave propagation in periodic systems. It has been widely used in physics to obtain the energy bands of various translationally-periodic cristals [1] and with the advent of nanosciences like nanotubes, it has been extended to additional symmetries using group theory. However, this work is restricted to homogenous equations. For complexe problems, as engineering structures, the peridic unit cell are often discretized and Bloch method is restricted to translational periodicity.

The goal of this session is to generalize the direct [2] and transfer propagation [3] Bloch method to structures with in plane glide plane or screw axis symmetries by deriving appropriate boundary conditions. Dispersion relations for a set of problems (Fig. 1) is then given and compared to results from the classical method, if available. It is found that (i) the dispersion curves are easier to interpret, (ii) the computational cost and error is reduced, and (iii) the revisited Bloch method is applicable to structures that do not possess purely-translational symmetries for which the classical method is not applicable (Fig. 1c).

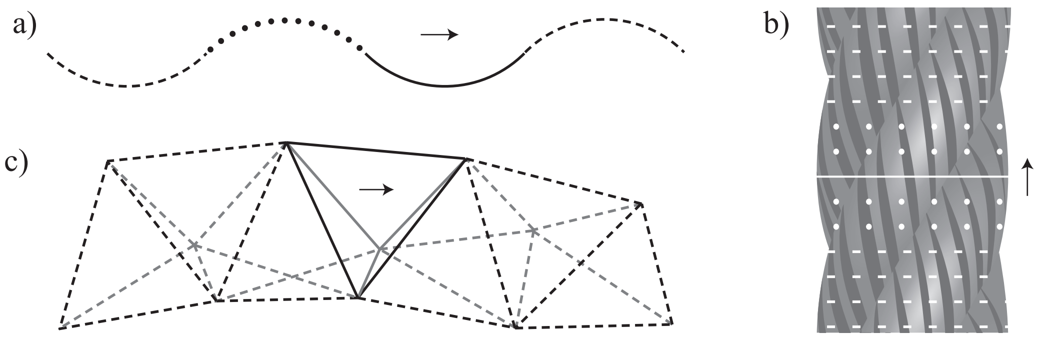

Figure 1: Buckled beam with translational and glide plane symmetries (a), twisted cable with translational and screw axis symmetries (b), and tetrahelix with screw axis symmetries only (c). Unit cell considered are in dotted/full line for the classical Bloch and full line only for the revisited Bloch theorem. Note that in (b), the unit cell considered with the modified Bloch theorem can be an infinitesimal slice of cable. In (c), classical Bloch theorem can not be used since there are no translational symmetries in tetrahelix (the rotation angle of the screw is not a fraction of π).

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