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OPTIMIZATION OF AXIALLY MOVING LAYERED WEB

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Abstract: The stability analysis and optimization of elastic web travelling between two rollers with a constant velocity are presented. The mathematical model for a layered travelling web (continuous isotropic composite plate) is developed restricting the consideration to one open draw. The layered plate with various mechanical properties of layers is considered and analytical expressions for the effective characteristics are derived. As a result the composed structure can be considered as an isotropic homogeneous plate and the obtained formulas for computation of critical velocity can be applied. Then the isoperimetric optimization problem is formulated and studied. The total mass of the layered plate is considered as an isoperimetric condition. The critical divergence velocity is taken as an optimized quality criterion. To this end consisted in maximization of the web stability and for maximization of the divergence velocity with respect to material distribution, the evolutionary optimization method (genetic algorithm) is applied. The number of materials is supposed to be given. Applying the genetic algorithm we distribute these materials on the plate thickness (provide the optimal plate consisted of some layers of different thickness) and maximize the critical velocity under the constraint on the total mass of the structure. Numerical results are presented for different sets of problem parameters. It is noted that the considered problem and applied approach can be generalized and also used for the cases with incomplete data concerning the properties of materials.