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Wave-spectrum of domino-system

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In [1, 2] we proposed a mathematical model of recently identified shear rupture mechanism. This model gives the simplest description of the fan-mechanism and demonstrates that the fan-head represents a self-unbalancing the domino-structure. The domino-structure plays an essential role in determination of rock instability at failure and causes spontaneous rupture development. In the framework of the proposed model it is possible to understand how shear rupture mechanism can provide propagation of faults through the highly confined intact rock mass at shear stress levels significantly less than frictional strength of pre-existing faults.

Mathematical model of the domino-structure is described by the system of coupled inverted pendulums. The case of small linear oscillations in a vicinity of the stable equilibrium position is studied and described in the literature [3]. In particular, the wave spectrum is calculated exactly.

In our work we considered the mathematical 1D model of the weak coupling inverted pendulums. The corresponding equations for a finite number of pendulums are obtained. We calculated the wave spectrum for the case of linear interaction between pendulums. It was found that there is the critical value of a parameter separating different modes of the wave behavior. This parameter is linked with the dimensionless interaction parameter. If the value of the parameter is less than the critical one we have oscillatory process. In other case the wave spectrum contains exponentially growing contributions and the domino-system is unstable. The asymptotic formula for the critical value with respect to N is proposed in the work. It is shown that the critical value decreases monotonically with respect to N.

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References

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