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Modelling of flutter running waves in turbine blades cascade

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Abstract: Flutter running waves in turbine blade cascade were often observed at experimental investigation of blades vibrations, but theirs detailed analysis has not yet been sufficiently realized. This contribution tries to explain origin and behavior of running flutter waves in the rotating blade cascade excited by steam flow from the stationary bladed disk. One of possible reasons for existence of running waves are the running periodic forces from steam wakes due to different numbers of blades of stationary and rotating wheels. Properties – velocities, directions and modes – of these forced running waves are shown using computational model of turbine disk with 10 blades. Interaction of this kind of forced excitation with aero-elastic self-excitation – flutter – causes origin of the flutter running waves. These flutter waves, modelled by the Van der Pol formula, are analyzed in the paper for this simplified form of aero-elastic self-excitations.

Keywords: Blade cascade, running waves, forced excitation, flutter.

Introduction

Dynamic properties of blades cascades in turbines excited by the external periodic forces or by aero-elastic effects of flowing gas – flutter – have been intensively studied during several last decades (e.g. [1-3]). Related to this, existence of running waves was observed and described. Main attention has been given to running waves in connection with origin of classical flutter. From large number of publications oriented on the flutter phenomenon and running waves in cascades let us mention in particular [4-6]. Some methods of analytical solution of blades vibration with flutter phenomenon are presented in [4, 5, 7]. Dynamic properties of closed 10 blades bundle modelling turbine blades wheal are analysed in the conference publications [8-13], where the blades are modelled as systems with one DOF. Due to the different numbers of blades of stationary and of rotating wheels, the running waves