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DEVELOPING A MODEL FOR MODULATING MIRROR FIXED ON ACTIVE SUPPORTS. DETERMINISTIC PROBLEM[1]

Abstract. We consider a problem of a modulating a mirror fixed on active supports. It is assumed that the mirror may have several defects. The problem is to find optimal locations of supports as well as control forces providing the best approximation of a given shape and phase of the oscillations for a homogeneous mirror as well as a plate with defects that have definite geometric and mechanical characteristics. The model of the Kirchhoff plate is chosen to describe the mirror. Defects are modeled by small inhomogeneities with changed elastic characteristics. An iterative technique for modeling finite-size defects in the Kirchhoff plate by point quadrupoles is developed. Isolated active supports are modeled by point forces. The optimization parameters are: the location of the supports and the amplitudes and phases of forces that generate vibrations. As an optimality criterion, the minimum of the root-mean-square deviation of the waveform of the plate from the given pattern is used.

Keywords: modulating mirror, defected plate, optimal excitation.

INTRODUCTION

In this work we generalize results obtained before in [1, 2]. We optimize parameters of mechanical devices for excitation and formation of wave motion. These devices can be used for generation, transformation, and transmission of information (and in more general sense transmission of wave energy). Particularly, we consider a problem of modulating a mirror fixed on active supports [2], and developed a model for optimizing of structure of these supports [1]. The problem is to find control forces and their characteristics (application points, amplitude and phase of oscillation), which provide the best approximation of a given shape and phase of the mirror oscillation taking into consideration structural inhomogeneities (defects) with unknown geometric and mechanical characteristics [3]. Mechanical properties of the defects are described by the following parameters: material density, Young's modulus of material, and cylindrical stiffness. We considered that any defect has elliptical form with stochastic parameters [4, 5]. To speed up calculations, we simplified the elliptical defect model and showed that in the first approximation equivalent body load does not depend on defect orientation [4]. We estimated error for the first approximation [5, 6]. We investigated how defect modeling accuracy depend on number of circular harmonics [6].

In this part of the study, we solve a deterministic problem in which it is assumed that the characteristics of defects are known. Thus, the problem of determining the shape of the plate vibration is reduced to a boundary problem with distributed point quadrupoles, which, in the first approximation, model inhomogeneities with known characteristics. Modeling of active supports by point forces makes it possible to use the Green's function method.

We also formulate an optimization problem in order to determine the best characteristics of the exciting forces, namely, their location, amplitudes and phases, which

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