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G. ZRAZHEVSKY
Taras Shevchenko National University of Kyiv, Kyiv, Ukraine,
e-mail: *zgrig@univ.kiev.ua.*

V. ZRAZHEVSKA
National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Kyiv, Ukraine,
e-mail: *vera.zrazhevska@gmail.com.*

O. GOLODNIKOV
V.M. Glushkov Institute of Cybernetics of NAS of Ukraine, Kyiv, Ukraine.

DEVELOPING A MODEL FOR THE MODULATING MIRROR FIXED ON ACTIVE SUPPORTS: A STOCHASTIC MODEL[1]

Abstract. The paper proposes a stochastic version of the problem of modulating a mirror fixed on active supports. It is assumed that the mirror has several defects of elliptical form with stochastic parameters. The problem is to find the control forces that provide the best approximation of a given shape and phase of the mirror oscillation taking into consideration defects with undefined geometric and mechanical characteristics. It is supposed that the system works inappropriately (i.e., "fails") if the phase or amplitude deviates from the target more than some specified threshold. To minimize the risk of such deviation, we use Buffered Probability of Exceedance (bPOE) as a measure of risk.

Keywords: risk; CVaR; bPOE; structural reliability; modulating a mirror; amplitude and phase of oscillation; optimization..

INTRODUCTION

Usually, in reliability engineering, risk is quantified by probability of failure, which is the chance that a system fails to carry out its intended task. Although failure probability is very popular, it has undesirable mathematical properties, such as discontinuity of sample distributions. Therefore, it is very difficult to optimize probabilities. To overcome these shortcomings a new alternative risk measure Buffered Probability of Failure (BPF) was developed in [1]. It takes into account the degree of exceeding the failure threshold $h = 0$ and is more conservative than the classical probability of failure. Buffered Probability of Exceedance, bPOE, proposed in [2], generalizes BPF in the case where the failure threshold of the system can be any number (not just 0). These risk measures are based on the properties of the CVaR risk measure [3, 4]. bPOE has exceptional mathematical properties (under general conditions bPOE is quasi-convex with respect to the random variable).

In this paper we develop stochastic version of a model, which optimizes parameters of mechanical devices for excitation and formation of wave motion, developed in [5]. Particularly, we consider stochastic model for modulating mirror fixed on active supports taken into consideration multiple defects (inhomogeneities) located on the mirror. It is supposed that a number of defects located on the mirror and their characteristics are uncertain. The problem is to find control forces and their location providing the best approximation of a given shape and phase of the oscillations for the mirror under uncertainty.

1. DETERMINISTIC MODEL

Consider deterministic model, which optimizes parameters of mechanical devices for excitation and formation of wave motion, developed in [5]. Let $I+1$ forces with intensities $F_k = u_k + iv_k$, $k = 0,\dots,I$, be applied to the plate at points $\xi_0(0)$, $\xi_k(r_{\xi_k}, \varphi_{\xi_k})$, $k = 0,\dots,I$. It is supposed that one force, F_0, is always located at the

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