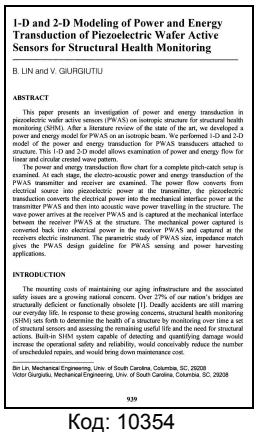
1-D and 2-D Modeling of Power and Energy Transduction of Piezoelectric Wafer Active Sensors for Structural Health Monitoring

B. LIN and V. GIURGIUTIU

ABSTRACT

This paper presents an investigation of power and energy transduction in piezoelectric wafer active sensors (PWAS) on isotropic structure for structural health monitoring (SHM). After a literature review of the state of the art, we developed a power and energy model for PWAS on an isotropic beam. We performed 1-D and 2-D model of the power and energy transduction for PWAS transducers attached to structure. This 1-D and 2-D model allows examination of power and energy flow for linear and circular crested wave pattern.

The power and energy transduction flow chart for a complete pitch-catch setup is examined. At each stage, the electro-acoustic power and energy transduction of the PWAS transmitter and receiver are examined. The power flow converts from electrical source into piezoelectric power at the transmitter, the piezoelectric transduction converts the electrical power into the mechanical interface power at the transmitter PWAS and then into acoustic wave power travelling in the structure. The wave power arrives at the receiver PWAS and is captured at the mechanical interface between the receiver PWAS at the structure. The mechanical power captured is converted back into electrical power in the receiver PWAS and captured at the receivers electric instrument. The parametric study of PWAS size, impedance match gives the PWAS design guideline for PWAS sensing and power harvesting applications.

INTRODUCTION

The mounting costs of maintaining our aging infrastructure and the associated safety issues are a growing national concern. Over 27% of our nation's bridges are structurally deficient or functionally obsolete [1]. Deadly accidents are still marring our everyday life. In response to these growing concerns, structural health monitoring (SHM) sets forth to determine the health of a structure by monitoring over time a set of structural sensors and assessing the remaining useful life and the need for structural actions. Built-in SHM system capable of detecting and quantifying damage would increase the operational safety and reliability, would conceivably reduce the number of unscheduled repairs, and would bring down maintenance cost.

Bin Lin, Mechanical Engineering, Univ. of South Carolina, Columbia, SC, 29208
Victor Giurgiutiu, Mechanical Engineering, Univ. of South Carolina, Columbia, SC, 29208

939

Код: 10354

B. Lin, V. Giurgiutiu

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Ключевые слова:

Содержание.