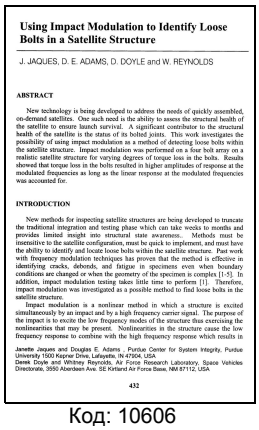
Using Impact Modulation to Identify Loose Bolts in a Satellite Structure

J. JAQUES, D. E. ADAMS, D. DOYLE and W. REYNOLDS

ABSTRACT

New technology is being developed to address the needs of quickly assembled, on-demand satellites. One such need is the ability to assess the structural health of the satellite to ensure launch survival. A significant contributor to the structural health of the satellite is the status of its bolted joints. This work investigates the possibility of using impact modulation as a method of detecting loose bolts within the satellite structure. Impact modulation was performed on a four bolt array on a realistic satellite structure for varying degrees of torque loss in the bolts. Results showed that torque loss in the bolts resulted in higher amplitudes of response at the modulated frequencies as long as the linear response at the modulated frequencies was accounted for.

INTRODUCTION

New methods for inspecting satellite structures are being developed to truncate the traditional integration and testing phase which can take weeks to months and provides limited insight into structural state awareness. Methods must be insensitive to the satellite configuration, must be quick to implement, and must have the ability to identify and locate loose bolts within the satellite structure. Past work with frequency modulation techniques has proven that the method is effective in identifying cracks, debonds, and fatigue in specimens even when boundary conditions are changed or when the geometry of the specimen is complex [1-5]. In addition, impact modulation testing takes little time to perform [1]. Therefore, impact modulation was investigated as a possible method to find loose bolts in the satellite structure.

Impact modulation is a nonlinear method in which a structure is excited simultaneously by an impact and by a high frequency carrier signal. The purpose of the impact is to excite the low frequency modes of the structure thus exercising the nonlinearities that may be present. Nonlinearities in the structure cause the low frequency response to combine with the high frequency response which results in

Janette Jaques and Douglas E. Adams , Purdue Center for System Integrity, Purdue University 1500 Kepner Drive, Lafayette, IN 47904, USA
Derek Doyle and Whitney Reynolds, Air Force Research Laboratory, Space Vehicles Directorate, 3550 Aberdeen Ave. SE Kirtland Air Force Base, NM 87112, USA

432

Код: 10606

J. Jaques, D.E. Adams, D. Doyle, W. Reynold

Using Impact Modulation to Identify Loose Bolts in a Satellite Structure

Издательство DEStech Publications, Lancaster, 2010 год

6 стр; формат: 23,5 x 16 см; библиографический список: 5 единиц
ISBN: 978-1-60595-024-2

New technology is being developed to address the needs of quickly assembled, on-demand satellites. One such need is the ability to assess the structural health of the satellite to ensure launch survival. A significant contributor to the structural health of the satellite is the status of its bolted joints. This work investigates the possibility of using impact modulation as a method of detecting loose bolts within the satellite structure. Impact modulation was performed on a four bolt array on a realistic satellite structure for varying degrees of torque loss in the bolts. Results showed that torque loss in the bolts resulted in higher amplitudes of response at the modulated frequencies as long as the linear response at the modulated frequencies was accounted for.

Ключевые слова:

Содержание.