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Correlation of Finite Element Analysis to Vibrational Measurement Data

Introduction

Synopta GmbH offers development and production of opto-electronic instrumentation for space and industrial applications. The coarse pointing assembly (CPA) is a beam pointing and stabilization system used for laser communication in space and in optical ground stations.

Shaker vibration tests on the CPA70 prototype show clear deviation to computed results with the finite element method (FEM). For the sake of future simulation analyses, this bachelor thesis has the purpose of investigating the finite element (FE) model and used modeling techniques to achieve data correlation of the measurement data.

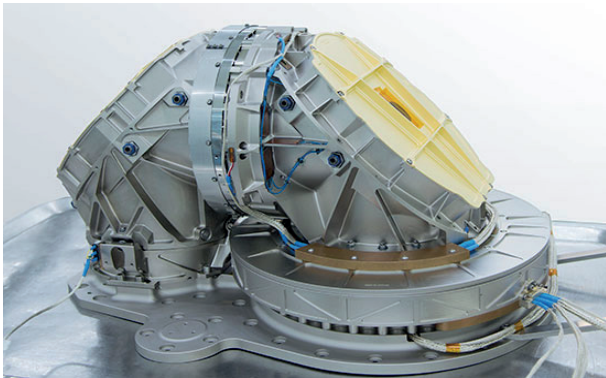


Fig. 1: CPA135 Prototype

Procedure

The passed-on FE model has been built in the Femap software, using Simcenter Nastran as solver. After repeated simulations, the results of the received FE model were verified. The research for deviation causes showed, that the omission of equivalent cross section calculations of the bolted connections led to discrepancies in the results. Furthermore, a new version of the base plate was not integrated, and old bearing stiffness parameters were used. The model was corrected accordingly, and thus led to a corrected finite element analysis (FEA) in Femap/ Nastran.

An independently built FE-model in Ansys serves as a comparison model. It contains 3D solid elements for the bolts and integrates the updated base plate. A study of different modeling techniques resulted in a bearing implementation by using the bushing joint. Figure 2 shows the first mode shape of the CPA70 assembly.

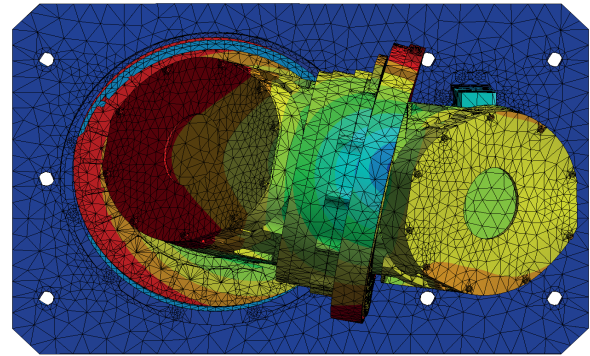


Fig. 2: Modal Analysis: 1. Mode of the CPA70

Results

The power spectral density (PSD) responses for three locations were evaluated. Correcting the bolted connections and bearings stiffnesses in Femap led to a significant improvement of data correlation, as seen in Figure 3. Likewise, a modal analysis and random vibration analysis in Ansys were performed. They provide satisfactory results in y-, and z-direction. In the x-direction, yet the corrected Femap model achieves better correlation.

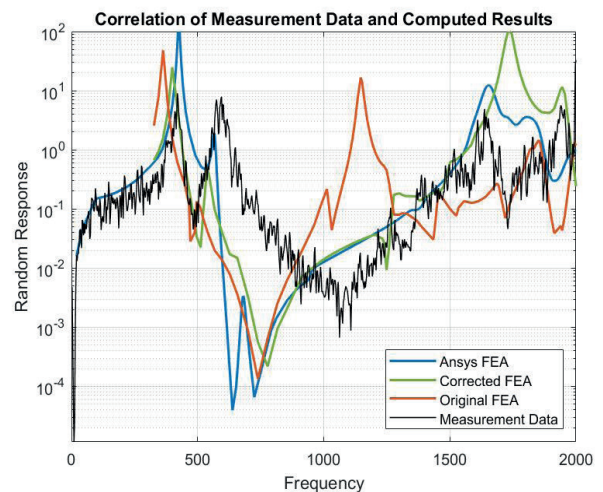


Fig. 3: Power Spectral Density (PSD) response of different finite element analyses, compared to the vibrational measurement data