Vibro-acoustic analysis optimization methods on filter foil for optical satellite instruments

Semester-/Bachelor-/Master-Thesis

Work Description
The design of satellite systems includes consideration of vibro-acoustic loads due to rocket engine exhaust noise. The challenge is that structural vibration loads as well as acoustic noise are combined. At the same time, all requirements for instrument operation in space have to be fulfilled.

Optical satellite instruments typically need optical filters (with a thickness in ranges of nm) for specific observations in space. Filters are mounted on wheels which provide several operation modes (see Figure below). As filter foils commonly show high area-to-mass ratios, these are very sensitive to acoustic noise. Within this frame, a FEM model should be created and an analysis on different acoustic pressures shall be investigated for the filter foil. Analysis and optimization methods can be performed in a vibro-acoustic analysis with the help of the software COMSOL. By performing a parametric study with different foil configurations and differential pressures an optimized geometry for the filter foil (thickness, frame, mesh etc.) shall be investigated. For verification of analysis results a simplified test set-up can be optionally created. This work is done in cooperation with the Max-Planck-Institute of extraterrestrial physics (MPE).

Goals
- Literature survey on vibro-acoustic analysis methods
- Requirements definition for filter based on overall system performance
- Define target functions/parameter sets
- Create FEM models with design parameters in COMSOL
- Perform parametric study in order to find optimized filter configuration
- Create simplified test set-up for analysis verification
- Documentation of results

Desired Skills
- High motivation in FEM modeling
- Suitable background in engineering mechanics
- Understanding of structural dynamics
- Understanding of FEM: ANSYS, Comsol, Nastran etc.
- Good knowledge of MATLAB
- Language: German or English

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Type of Work
☐ Practical
☑ Theoretical
☑ Experimental

Published: 10.04.2019