FEM Design of Interferometric FBGL Based Accelerometer for Underwater Applications

Malu Balachandran[1], R Rajesh[1], Sreehari C V[1], Khansa C A[1], K P B Moosad[1]

[1] Naval Physical and Oceanographic Laboratory, Kochi, Kerala, India

Abstract

Fiber optic sensors have been designed for applications ranging from simple proximity detectors to state of the art inertial navigation systems. The optical sensing technique used in each of these applications depends primarily on the requirements. Fiber Bragg Grating Laser (FBGL) based accelerometer offers highest sensitivity among all accelerometers and also enjoys all kind of advantages related to fiber optic sensors. Improving sensitivity and bandwidth is a primary consideration for most sensor designs. Here we have designed an FBGL based accelerometer using cantilever concept for achieving high bandwidth and sensitivity. For attaining high bandwidth, stainless steel was selected as material for the cantilever structure, which is also suitable for the aimed underwater applications with it. Sensitivity and bandwidth of the cantilever based accelerometer is further enhanced by using a patch between the cantilever and FBGL sensor. The proposed cantilever based accelerometer is performance analyzed using the numerical simulations with COMSOL Multiphysics® for various geometrical parameters. In this work we have used the Structural Mechanics Module of COMSOL Multiphysics® to model the sensor. The geometry in figure 1 was used and studies like Eigen frequency, frequency domain analysis etc. were carried out. The proposed structure has a cantilever with small dimensions in mm and a mass is attached at one end. COMSOL Multiphysics® allowed us to evaluate the performance of the device with a variety of loading masses, different materials for cantilever structure; different patch materials etc. The sensitivity improving component in the design is the patch or layer attached to the cantilever surface. The results obtained shown good agreement with the analytical study and also sensitivity and performance of the sensor was improved. The results from COMSOL Multiphysics® analysis helped in obtaining the sensitivity of the sensor, proper understanding about the Eigen frequency modes and characteristics of the sensor depending on material selected and boundary conditions. The obtained FEM results shows considerable sensitivity over a good working range of frequencies, and will be discussed in detail in the paper.

Figures used in the abstract

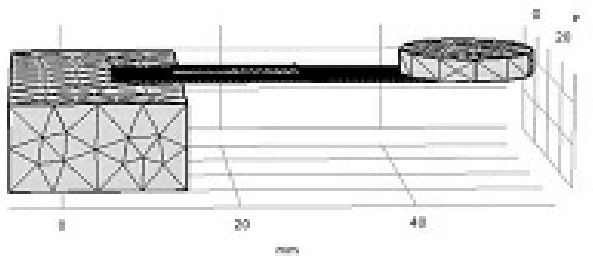

Figure 1: Meshed Configuration Of The Structure