Chapter 3


Pravin P. Patil

Graphic Era University, India

ABSTRACT

The main objective of this chapter is FEA simulation of resonating tube with different size and material configuration for evaluation of resonant frequency. Resonating tube is an important component of Electro-Mechanical Mass Flow Sensor (EMMFS) used for measuring direct mass flow. Omega and U-shaped resonating tube type EMMFS have been investigated for 200mm, 300 mm and 400mm height with three different materials Copper, Aluminium and Mild Steel. EMMFS analysis is highly nonlinear study having fluid structure interaction. To simplify the solution large deformations in resonating tube countered to be absent. Sensing points are located symmetrically at limbs of resonating tube to sense the phase shift for measuring mass flow rate. FEA simulation of EMMFS has been done using Ansys. Solid Edge and Pro-E has been used for modeling of omega and U-shaped resonating tube.

DOI: 10.4018/978-1-5225-3722-9.ch003
INTRODUCTION

Finite Element Analysis (FEA) is advanced numerical simulation technique applied in all engineering fields. Now days it has vast application subjected to highly nonlinear analysis in different engineering problems (Sharma 2010, Patil 2012). In this chapter, fluid carrying tube with omega shape has been analysed. Tube vibrates at its fundamental frequency. Flowing fluid inside tube apply forces on tube walls due to this mode shape changes (Cheesewright, 2003). Advanced coriolis mass flow sensors are independent of viscosity and density of flowing fluids. During flow inside tube generated velocity profile and obtained Reynolds number of the flow does not affect the flow meter as compared to others conventional flow meters based on volume measurements (Anklin, 2006). Coriolis flow meter is also used for measuring fluid density by measuring change in natural frequency (Bobovnik, 2005). Many Authors have numerically investigated working method of Coriolis flow meters. In coriolis flow meters there are no moving parts only fluid carrying flow tube vibrates with small amplitude (Mole 2008, Wang 2014, Saravanan 2015 and Rongmo 2013).

Mass flow study is highly nonlinear problem. To simplify the solution, it is assumed that large deformations in fluid tube are absent. Finite Element Analysis (FEA) is an advanced technique used for complex geometry analysis. Artificial Neural Network (ANN) based model was developed for copper type CMFS (Patil 2014). The developed model has been found in agreement with experimental setup model. Modelling of CMFS using Adaptive neuro-fuzzy inference system (ANFIS) has been studied (Patil 2014) to check the influence of material. The input parameters are tube material, drive frequency, sensor location and height of tube. Using various parameters performance of mass flow sensor has been predicted. Material influence is an important criterion to check the structural rigidity and performance. Material based free vibration analysis was performed for transmission system using FEA (Kumar, 2015). Author has used Fuzzy interference system tools for comparison of texture and CMFS study. Coriolis effect and new straight coriolis flow meter has been investigated by researcher (Ying, 2008) for further development.

RESONATING TUBE CONFIGURATIONS

In general omega and U shaped resonating tubes are used in EMMFS. It is observed from previous studies that Omega tube produces more accurate and reliable results in comparison to U shaped tube. Geometric properties of resonating tube are its tube height, internal diameter and external diameter. Solid Edge, Pro-E was used for modelling of omega and U shaped tube. The tube material is taken as Copper,
Optimization of Process Parameters in Plasma Arc Cutting Applying Genetic Algorithm and Fuzzy Logic

Application of Grey Taguchi based Response Surface Methodology (GT-RSM) in Injection Moulding of Polypropylene/E-glass Composite