Finite Element Analysis to Investigate Electromagnetic Flowmeters of Diverse Cross-sectional Shapes

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Abstract

Electromagnetic (EM) flowmeters are important flow sensing devices across industries like oil and gas and power generation. The EM flowmeter works on the principle of Faraday's law of electromagnetic induction. In short, when an ionic fluid like water flows through a pipe, in the presence of an imposed magnetic field, an EMF or electromotive force is induced within the fluid. The EMF is proportional to fluid velocity and by measuring it, velocity can be estimated. While modern EM flowmeters exhibit excellent performance, it is ever desirable to modify design of the sensor for better performance. Several studies in the past have investigated methods to improve flowmeter performance parameters, like the sensitivity which is induced EMF divided by fluid velocity. One factor that has been less studied and is theme of this paper, is the flowmeter pipe cross sectional shape and how it influences sensitivity. In this study a multi-physics model of the EM flowmeter is developed in COMSOL Multiphysics® integrating the physics of flow dynamics and electromagnetism. The model is used to study the impact of various cross sectional shapes on flowmeter performance. The model is run in steady state, using segregated solvers. The challenge of the model is to integrate diverse physical phenomena, fluid dynamics and electromagnetism, which is overcome by COMSOL®'s multiphysics mathematical ability.

Figures used in the abstract

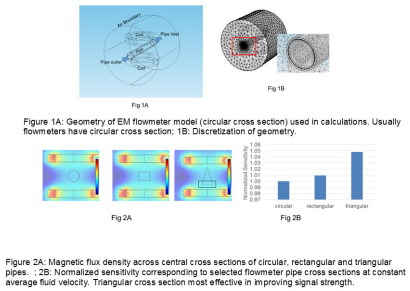

Figure 1