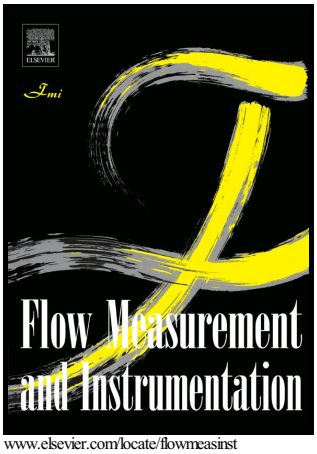
Density and velocity determination for single-phase flow based on radiotracer technique and neural networks

G.H. Roshani, R. Hanus, A. Khazaei, M. Zych, E. Nazemi, V. Mosorov



www.elsevier.com/locate/flowmeasinst

PII: S0955-5986(17)30175-9
DOI: https://doi.org/10.1016/j.flowmeasinst.2018.03.006
Reference: JFMI1430

To appear in: *Flow Measurement and Instrumentation*

Received date: 15 April 2017
Revised date: 4 October 2017
Accepted date: 18 March 2018

Cite this article as: G.H. Roshani, R. Hanus, A. Khazaei, M. Zych, E. Nazemi and V. Mosorov, Density and velocity determination for single-phase flow based on radiotracer technique and neural networks, *Flow Measurement and Instrumentation,* https://doi.org/10.1016/j.flowmeasinst.2018.03.006

Density and velocity determination for single-phase flow based on radiotracer technique and neural networks

G.H. Roshani[1,*], R. Hanus[2], A. Khazaei[1], M. Zych[3], E. Nazemi[4] and V. Mosorov[5]

[1] Electrical Engineering Department, Kermanshah University of Technology, Kermanshah, Iran
[2] Faculty of Electrical and Computer Engineering, Rzeszów University of Technology, Rzeszów, Poland
[3]Faculty of Geology, Geophysics and Environmental Protection, AGH University of Science and Technology, Kraków, Poland
[4] Nuclear Science and Technology Research Institute, Tehran, Iran
[5]Institute of Applied Computer Science, Lodz University of Technology, Lodz, Poland

Abstract

Measuring the density and velocity of fluids is one of the important tasks in oil and petroleum industries. The article demonstrates the measurements of these parameters precisely for different fluids and various diameters of pipes by using radiotracer injection and Artificial Neural Network (ANN). The required data for training and testing the ANN model were obtained by the MCNPX code simulations. Before using the simulation results for training the ANN, simulation geometry was validated with an experimental setup. The experimental setup consists of two 2-inch NaI(Tl) detectors that are positioned in distance of 120 mm from each other and one ^{133}Ba radioactive source as a tracer. It is shown that the estimated Mean Relative Error (MRE) of the density determination in presented system was less than 0.9%. The relative combined standard uncertainty of the fluid velocity measurement did not exceed 0.5 %.

Keywords: radiotracer, velocity, density, petroleum products, gamma radiation.

1. Introduction

The problem of how to correctly measure the density and velocity of fluids in a pipeline remains as one of the key challenges in the petroleum industry. In recent years, different methods have been introduced to determine fluid characteristics, but there has been an increasing interest in using gamma radiation technique, because utilizing gamma radiation technique has some

*Corresponding Author: hosseinroshani@yahoo.com, Tel: +989188564470