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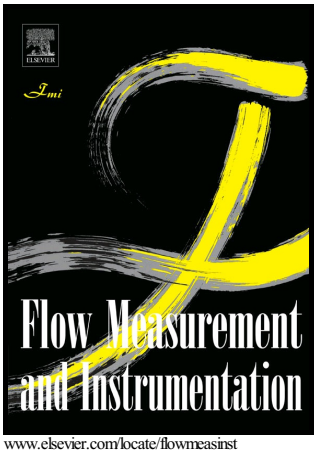

www.elsevier.com/locate/flowmeasinst

PII: S0955-5986(17)30324-2
DOI: https://doi.org/10.1016/j.flowmeasinst.2017.12.013
Reference: JFMI1397

To appear in: *Flow Measurement and Instrumentation*

Received date: 9 August 2017
Revised date: 6 December 2017
Accepted date: 28 December 2017

Cite this article as: Alexander Y. Gurevich, Mikhail G. Goman, Yuri G. Gurevich and Armando M. Lopez, Synthetic Turbulence Modeling for Evaluation of Ultrasonic Cross-Correlation Flow Measurement, *Flow Measurement and Instrumentation,* https://doi.org/10.1016/j.flowmeasinst.2017.12.013

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Abstract

Performance of an ultrasonic cross-correlation flow measurement instrument may be significantly affected by turbulence at the location of the ultrasonic sensors. In this paper, a new method of generating Synthetic Turbulence is presented, to provide an effective tool for creating a variety of turbulent fields, which can be used to model and analyze instrument performance under different flow conditions. In the proposed method, a turbulent field is presented as a Fourier time-series in each point in space. Turbulence structures are defined by a spatial distribution of phase functions for each harmonic. Principles of designing a phase function to achieve the desirable distribution of turbulence scales, and two-point correlations, are outlined by considering the example of Uniform Isotropic Turbulence. One application of this method, presented in this work, is the mathematical modeling of ultrasonic cross-correlation flow measurement. Results predicted by the proposed mathematical model show good agreement with experimental data.

Keywords: synthetic turbulence, turbulence model, ultrasonic flow measurement, cross-correlation flow meter, non-intrusive flow measurement

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