MODELLING AND SIMULATING OF AN ULTRASONIC FLOW MEASURING SYSTEM*

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Abstract

Ultrasonic measuring systems using a single beam to determine the discharge in pipes are state of the art. Current systems measure the velocity along one ultrasonic beam evaluating echoes from particles, which are moved with the flow. These data are extrapolated afterwards to calculate the mean velocity of the cross section by using standard calibration parameters. The total discharge is determined by multiplying the mean velocity with beforehand determined cross section of the pipe.

This principle can hardly be used in open channels due to complex and changing cross sections of the flume. The weaknesses of this measuring system applied in pipes and channels is the accurate determination of the mean velocity and the correct cross section. Both are effected by the channel shape up- and downstream as well as by the channel roughness. Sedimentations may cause variations of the cross section, too. Accurate calculation of the velocity flow requires permanent adaption of the standard calibration parameters. Well calibrated systems reveal measurement errors of roughly $\pm 5\%$.

To overcome these weaknesses the new method includes continuous measurements of the contour of the channel and of the flow velocities along the main cross section. This requires a new ultrasonic front end technology.

Modelling and simulation of the system enables the design of signal processing algorithms related with the new ultrasonic front end, the transmitted signals and the evaluation of the echoes. The final product may generally be used for flood prediction and water management in all types of flumes.

Keywords: Ultrasonic measuring system, modelling, simulation, signal processing methods, open channels, pipes, computational fluid dynamics.

Presenting Author's Biography

Manuel Haide studied at the University of Applied Sciences in Ulm. He graduated with a German degree in Industrial Electronics and a Master of System Engineering. Presently he is a member of the research staff at the Institute for Applied Research in Ulm. The focus of his work is to specify and analyze different signal processing methods for a new ultrasonic phased array system.

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