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Multibeam Optical System and Neural Processing for Turbidity Measurement

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Abstract

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Abstract:
This paper presents a turbidity measuring system based on a modulated four infrared (IR) light beam architecture with advanced data processing. The turbidity sensing component consists of a pair of IR light-emitting diodes (LEDs) connected to a current drive controlled through the pulsewidth modulated (PWM) outputs of a multifunction input/output board. The scattered and transmitted IR light in the media under test is detected by a two-channel IR photodiode module that includes a set of transimpedance and programmable gain amplifier. The voltages proportional to the detectors' output currents, are acquired using a 12-bit ADC included in a microcontroller and RS232 transmitted to a laptop personal computer (PC) that works as an advanced control and processing unit. Using optimal neural network processing architectures, an accurate extraction of the turbidity information is performed. A practical approach concerning the neural network architectures [multilayer perceptron single-input-single-output (SISO), multiple-input-single-output (MISO)] including neural network training and testing is discussed in the paper. The multi-input architectures prove to be a robust and general solution for the proposed application. Results from a turbidity measuring system that was designed for automated standalone remote operation with sensing channel autocalibration capabilities are presented

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Contents

I. Introduction

Turbidity is a quantity introduced in order to express the degree of clarity of a liquid and, in particular of water, the liquid of our interest and that we exclusively consider in the present paper. It is a quantity often used as an indicator of the amount of suspended sediments in water, which are the most widespread pollutants of surface water. High turbidity in surface water means high concentrations of suspended solids, reducing algal populations, and harming fish and other aquatic fauna by inhibiting sunlight and slowing down photosynthesis [1]. Regular monitoring of turbidity can help to detect trends that might indicate increasing waste discharge or excessive algal growth.

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