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Advantages of PWM-A/D Conversion Techniques in Smart Sensing Systems

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J.M. Pereira ; O. Postolache ; Feng Dengchao ; V. Viegas ; P. Girao   **All Authors**

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Wideband base station receiver with analog-digital conversion based on RF pulse width modulation

2013 IEEE MTT-S International Microwave Symposium Digest (MTT)

Published: 2013

A Digitally Programmable A/D Converter for Smart Sensors Applications

IEEE Transactions on Instrumentation and Measurement

Published: 2007

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Abstract:

This paper dedicates a particular attention to pulse-width modulation (PWM) analog-to-digital (A/D) conversion techniques underlining their importance in smart sensing systems. Nowadays, smart sensing systems and advanced signal processing techniques can improve measuring system's performance and flexibility relaxing hardware specifications and associated cost. The integration of sensing units, conditioning circuitry and A/D conversion is becoming trivial in a large number of instrumentation and measurement applications. In a large number of systems, linearization is generally required because most sensors have an intrinsic nonlinear characteristic or the presence of influence variables makes their characteristic nonlinear over its measuring range. Fortunately, digitalization and linearization can be performed in a single step nearby the transducer in smart sensing systems. A possible solution to achieve this goal is based on a PWM scheme for nonlinear A/D conversion. The proposed A/D conversion method is easily implemented in low-cost microcontrollers that generally include comparator inputs and PWM outputs. The input voltage range can be divided in several intervals and the nonlinearity profile of the A/D in each interval can be dynamically adapted if results from calibration or auto-calibration are available even when hysteresis effects are present. The paper includes some simulation results obtained with MATLAB and an experimental result of a strain gage system linearization is also presented in the final part of the paper.

Published in: 2007 8th International Conference on Electronic Measurement and Instruments

☰ Contents

1 Introduction

An ideal device or system is one for which cause and effect are proportional. The linearity conducts to linear characteristics, i.e., a constant sensitivity of the measurement system over its measuring range. However, all devices, particularly sensors, are nonlinear even when a restricted measuring range is considered. Much design effort is dedicated in finding and using devices with exceptional linearity, and in the development of conditioning and normalizing circuits to match or compensate nonlinear effects that are always present [1].

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