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Instrumentation, Measurement, Circuits and Systems

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Preface

This year the 9th WSEAS International Conference on INSTRUMENTATION, MEASUREMENT, CIRCUITS and SYSTEMS (IMCAS '10) was held in Hangzhou, China, April 11-13, 2010. The conference remains faithful to its original idea of providing a platform to discuss instrumentation, electrical and electronic measurement, real-time systems, optoelectronics, automatic control and robotics, mechatronics, machine vision, power systems, CAD/CAM systems, virtual reality, signal processing, microprocessors, computer architecture, software tools and environments etc. with participants from all over the world, both from academia and from industry.

Its success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of this conference are published in this Book that will be indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

A Conference such as this can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Optimization of Control Systems with Nuclear Radiation Meters

Professor Stanislaw Cierpisz
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Abstract: On-line nuclear meters have been in use in the industry for many years. They have been utilized for monitoring and control of liquid or solids levels in tanks and bunkers, density of liquids or monitoring of chemical composition of various materials processed in chemical plants. A wide use of radiometric measuring methods can be especially observed in the coal industry in the control systems for coal quality (ash content) stabilization or for separating coals in coal beneficiation processes.
Analysis and optimal synthesis of such monitoring and control systems is presented in the paper. Operation of an industrial nuclear radiation monitor (for example – a liquid density meter or ash content in coal analyser) is usually based on the scattering or the absorption of incident gamma radiation, and the derived parameter value (density, ash) is the result of a time-averaged measurement.
The output signal from the detector (scintillation counter) of gamma radiation is always a stochastic signal, regardless of the character of the input signal (i.e. density or ash content) modulating the intensity of the detected radiation beam. The longer the averaging time the higher the statistical (static) accuracy of the monitor. At the same time, if the input signal varies, the dynamic error of the measurement is higher. This suggests that for a given shape of the input signal and a given structure of the monitor circuit, one can find an optimal averaging time of input pulses, which gives the minimum dynamic error according to the accepted criteria. Furthermore, this leads to the application of a circuit with an adapting time constant. If the input signal is, for example, a step function and the nuclear radiation monitor is to reproduce this change, the time constant should be small at the beginning of the measurement to speed-up the reaction of the meter, and then it should become greater to read-out accurately the new value of measured parameter.
A nuclear radiation monitor used in a closed-loop control system generates a stochastic signal which results in stochastic fluctuations of the controlled parameter which, in consequence, modulates mean intensity of stochastic pulses from the detector, etc. In this way, non-stationary stochastic signals are generated in the control system which makes the system analysis difficult.
A simplified analytical method of a system analysis has been discussed in the paper. The method generally is based on the decomposition of a non-stationary signal to deterministic , time varying mean value, and a stationary noise. Parameters of both components depend on dynamic properties of the monitoring system. Such approach enables one to determine optimum transfer function of the closed loop system minimising the dynamic error of the control due to the accepted criterion. Comparison of optimisation results obtained from the simplified analytical approach and more accurate simulation analysis has been also presented.
The concept of an ash monitor with a time constant (or a time of measurement) adapting to variations of an input signal (ash content) has been analysed. The fuzzy logic has been applied to establish the structure of the adaptive filter. Such a system allows to speed-up the reaction of the instrument to rapid variations of ash content and at the same time to achieve better statistical accuracy for a longer period of time. This is particularly important in closed loop control systems or in splitting of a coal stream to different products.
Simulation analysis of the coal blending control system applied in the "Sosnica" plant has been presented in the paper. Application of an on-line ash monitor with an adaptive time constant has been discussed. The results of practical experiments have been presented in the paper.

Brief Biography of the Speaker:
Graduated from the Electrical Engineering Faculty at the Silesian University of Technology, Gliwice, Poland (1961). PhD in process control received in 1968. Fellowships: UN (British Council) (United Kingdom, 1969-70), ACTIM (France, 1974), Fulbright fellowship (USA, 1975-76), IEE Australia (Guest Speaker, 1985). For 12 years (1997-2009) he was the Head of the Department of Electrical Engineering and Process Control in Mining at the Silesian University of Technology, Poland. At present he is a full professor at the same University. Published 5 books and over 200 papers on process control in mining and minerals preparation. Interests: industrial process control, simulation techniques, tourism, skiing.